MODINE

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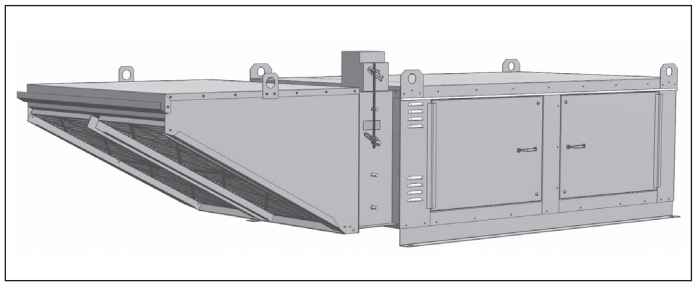
February, 2015

INSTALLATION AND SERVICE MANUAL
direct-fired make-up air units
models MDB/MRB



Model MDB is ETL certified to meet the U.S. and Canadian requirements in the latest version of ANSI Standard Z83.4, Non-Recirculating Direct Gas-Fired Industrial Air Heaters.

Model MRB is ETL certified to meet the U.S. requirements only in the latest version of ANSI Z83.18, Recirculating Direct Gas-Fired Industrial Air Heaters.

⚠ WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death, and could cause exposure to substances which have been determined by various state agencies to cause cancer, birth defects, or other reproductive harm. Read the installation, operating, and maintenance instructions thoroughly before installing or servicing this equipment.

FOR YOUR SAFETY

IF YOU SMELL GAS:
1. **Open windows (indoor installation only).**
2. **Do not touch electrical switches.**
3. **Extinguish any open flame.**
4. **Immediately call your gas supplier.**

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

IMPORTANT

The use of this manual is specifically intended for a qualified installation and service agency. A qualified installation and service agency must perform all installation and service of these appliances.

Inspection upon Arrival

1. Inspect unit upon arrival. In case of damage, report it immediately to transportation company and your local Modine Manufacturing sales representative.
2. Check rating plate on unit to verify that power supply meets available electric power at the point of installation.
3. Inspect unit upon arrival for conformance with description of product ordered (including specifications where applicable).

THIS MANUAL IS THE PROPERTY OF THE OWNER.
PLEASE BE SURE TO LEAVE IT WITH THE OWNER WHEN YOU LEAVE THE JOB.

SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS

THE INSTALLATION AND MAINTENANCE INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED TO PROVIDE SAFE, EFFICIENT AND TROUBLE-FREE OPERATION. IN ADDITION, PARTICULAR CARE MUST BE EXERCISED REGARDING THE SPECIAL PRECAUTIONS LISTED BELOW. FAILURE TO PROPERLY ADDRESS THESE CRITICAL AREAS COULD RESULT IN PROPERTY DAMAGE OR LOSS, PERSONAL INJURY, OR DEATH. THESE INSTRUCTIONS ARE SUBJECT TO ANY MORE RESTRICTIVE LOCAL OR NATIONAL CODES.

HAZARD INTENSITY LEVELS

1. **DANGER:** Indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.
2. **WARNING:** Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.
3. **CAUTION:** Indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury.
4. **IMPORTANT:** Indicates a situation which, if not avoided, MAY result in a potential safety concern.

⚠ DANGER

Appliances must not be installed where they may be exposed to a potentially explosive or flammable atmosphere.

⚠ WARNING

1. Do not install direct-fired units down stream from any cooling system which utilizes refrigerants for cooling.
2. All field gas supply lines should be pressure/leak tested prior to operation. Never use an open flame. Use a soap solution or equivalent for testing.
3. Gas pressure to the unit controls must never exceed pressure shown on the unit's rating plate. The unit and its individual shutoff valve(s) must be disconnected from the gas supply during any pressure in excess of 1/2 psig (3.5 kPa).
4. For test pressure less than 1/2 psig (3.5 kPa), the unit's gas control must be isolated from the supply gas piping by closing the unit's manual shutoff valve(s).
5. Use a dedicated line for venting gas to the outside of the building.
6. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.
7. All appliances must be wired strictly in accordance with the wiring diagram furnished with the unit. Any wiring different from the wiring diagram could result in a hazard to persons and property.
8. Any original factory wiring that requires replacement must be replaced with wiring material having a temperature rating of at least 105°C.
9. Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% greater than the rated voltage.
10. When servicing or repairing this equipment, use only factory-approved service replacement parts. A complete replacement parts list may be obtained by contacting Modine Manufacturing Company. Refer to the rating plate on the unit for complete appliance model number, serial number, and company address. Any substitution of parts or controls not approved by the factory will be at owner's risk.

⚠ CAUTION

1. Do not modify burner profile opening.
2. Purging of air from gas supply lines should be performed as described in ANSI Z223.1 – latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149 codes.
3. Since a failure of the unit may affect the proper operation of other fuel burning equipment in the building, the unit shall be electrically interlocked to open balancing air inlet dampers, or other such devices.
4. Do not operate unit with a gas input rate greater than that shown on the unit's rating plate.
5. When using a drill bit to clean the burner gas ports, do not distort or enlarge the ports. Do not use a power drill.
6. Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% less than the rated voltage.
7. Do not reuse any mechanical or electrical component which has been wet. Such component must be replaced.

IMPORTANT

1. Start-up and adjustment procedures should be performed by a qualified service agency.
2. To check most of the Possible Remedies in the troubleshooting guide listed in Table 46.1, refer to the applicable sections of the manual.
3. Installation in the airplane hangers must be in accordance with the Standard for Aircraft Hangars, ANSI/NFPA 409, and (2) public garage in accordance with the Standard from Parking Structures, ANSI/NFPA 88A, or the Standard for Repair Garages, ANSI/NFPA 88B and with CAN/CGA B149 Installation Codes.
4. Adequate building relief must be provided so as to not over-pressurize the building when the heating system is operating at its rated capacity. This can be accomplished by taking into account, through standard engineering methods, the building structure design infiltration rate; by providing proper sized relief openings; by interlocking a power exhaust system; or by a combination of these methods.
5. The heater inlet shall be located in accordance with the applicable code provisions for ventilation air.
6. Field constructed intake accessories should be properly designed to minimize the entry of snow and rain.
7. All air to the heater must be ducted directly from the outdoors. Recirculation of room air is not permitted.
8. If in doubt regarding the application, contact your local Modine Manufacturing sales representative.

TABLE OF CONTENTS / SI (METRIC) CONVERSION FACTORS / UNIT LOCATION

Table of Contents

Inspection upon Arrival 1
Special Precautions 2
SI (Metric) Conversion Factors 3
Unit Location 3
- Location Recommendations 3
- Sound and Vibration Attenuation 4

Mounting Options 4-6
- Suspended Units 4
- Rail Mounted Units 5
- Slab Mounted Units 5
- Roof Curb Mounted Units 6
- Roof Curb Installation 6
- Duct Installation 7

Utility Location 7
Rigging Instructions 7
Unit Installation 8-10
- Gas Connections 8
- Manifold Arrangements 9
- Electrical Connections 10

Prior to Operation 10-20
- Controls Descriptions 11-17
- Gas Controls 13-16
- Controls Locations 18-20

Start-Up Procedure 21-26
- Blower/Motor Adjustment 25
- Sequence of Operation 26

Control Applications 27-28
General Performance Data 29
Unit Selection 30-31
Accessory Static Pressure Drop and
- Blower Performance Data 32-35

Blower Sheave Assembly Data 36
Electrical Data 37
Unit and Accessory Dimensions 38-43
Unit and Accessory Weights 44
Maintenance 45-46
Service and Troubleshooting 46-47
Control Definitions 48
Start-up Report 49
Replacement Parts Ordering 50
Model Nomenclature 51
Warranty . . . . . Back Page

Table 3.1 - SI (Metric) Conversion Factors

To Convert	Multiply By	To Obtain
"W.C.	0.249	kPa
°F	(°F-32) x 5/9	°C
Btu	1.06	kJ
Btu/ft^3	37.3	kJ/m^3
Btu/hr	0.000293	kW
CFH (ft^3/hr)	0.000472	m^3/min
CFH (ft^3/hr)	0.00000787	m^3/s
CFM (ft^3/min)	0.0283	m^3/min
CFM (ft^3/min)	0.000472	m^3/s

To Convert	Multiply By	To Obtain
feet	0.305	m
Gal/Hr.	0.00379	m^3/hr
Gal/Hr.	3.79	l/hr
gallons	3.79	l
Horsepower	746	W
inches	25.4	mm
pound	0.454	kg
psig	6.89	kPa
psig	27.7	"W.C.

UNIT LOCATION

⚠ DANGER

Appliances must not be installed where they may be exposed to a potentially explosive or flammable atmosphere.

⚠ WARNING

Do not install direct-fired units down stream from any cooling system which utilizes refrigerants for cooling.

Location Recommendations

1. Do not locate any gas-fired equipment where chlorinated, halogenated or acid vapors are present in the combustion air atmosphere.
2. When locating units, consider general space and heating requirements and availability of gas and electrical supply.
3. Where necessary to provide working clearance beneath the unit, the unit shall be installed at a suitable height above the floor or otherwise adequately protected.
4. Be sure the structural support at the unit location is adequate to support the weight of the unit.
5. For economical installation and operation, locate each unit close to the space it will serve, and close to the utilities that will serve the unit.
6. Adequate building relief must be provided so as to not over-pressurize the building when the heating system is operating as its rated capacity. This can be accomplished by taking into account, through standard engineering methods, the building structure design infiltration rate; by providing proper sized relief openings; by interlocking a power exhaust system; or by a combination of these methods.
7. The heater inlet shall be located in accordance with the applicable code provisions for ventilation air.
8. All air to the heater must be ducted directly from the outdoors. Recirculation of room air is not permitted.
9. Be sure that the minimum clearances to combustible material and recommended service clearances are maintained. Units are designed for installation on non-combustible surfaces or combustible surfaces with the minimum clearances shown in Table 3.2
10. Field constructed intake accessories should be properly designed to minimize the entry of snow and rain.
11. If in doubt regarding the application, contact your local Modine Manufacturing sales representative.

Table 3.2 - Combustible Materials and Service Clearances

Model Size	Minimum Clearances to Combustible Materials				Minimum Clearance For Service Access (Both Sides)
	Top	Bottom	Sides	Ends	
All	6"	0"	6"	6"	30"

MOUNTING OPTIONS

Sound and Vibration Levels

All mechanical equipment generates some sound and vibration which may require attenuation. Locate the equipment away from critical areas whenever possible. Frequently, units can be mounted above utility areas, corridors, restrooms, and other non-critical areas. Generally, a unit should be located within 15 feet of a primary support beam. Smaller deflections mean less vibration and noise transmission.

Field-installed, factory-supplied vibration isolators are available for suspended or rail/slab mounted units. Internal, factory-mounted blower and motor isolation may be ordered as an option at the time the unit is ordered.

Figures 4.1 through 4.3 show how suspended or slab-mounted vibration isolators should be installed. For roof curb-mounted units (not supplied with factory-installed internal vibration isolation), Figure 4.4 shows suggested methods of sound attenuation.

Figure 4.1 - Vibration Hangers

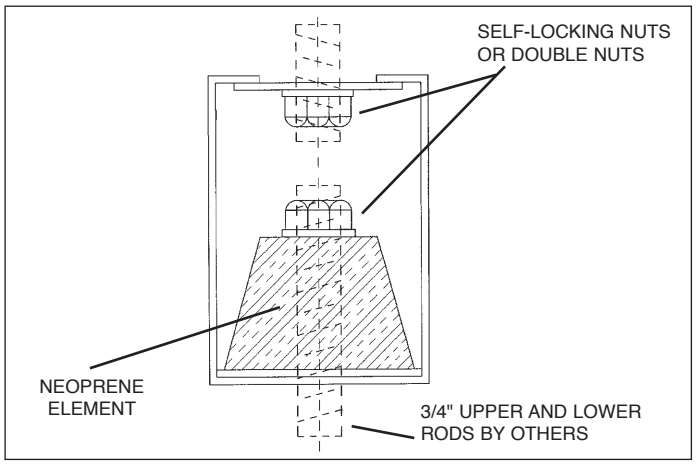


Figure 4.2 - Vibration Feet (Size 110-118)

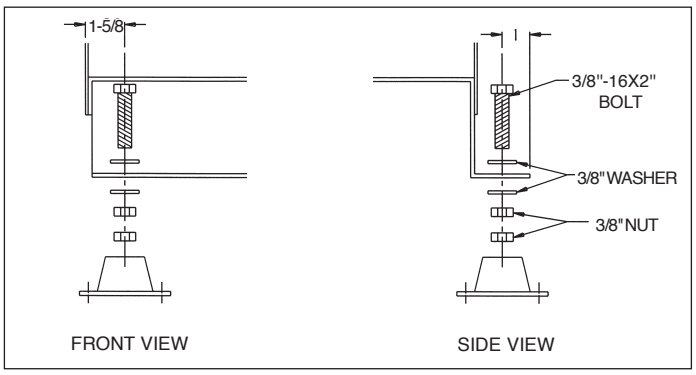


Figure 4.3 - Vibration Feet (Size 120-230)

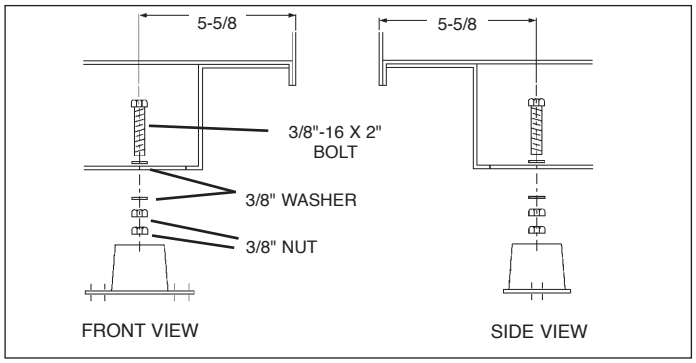
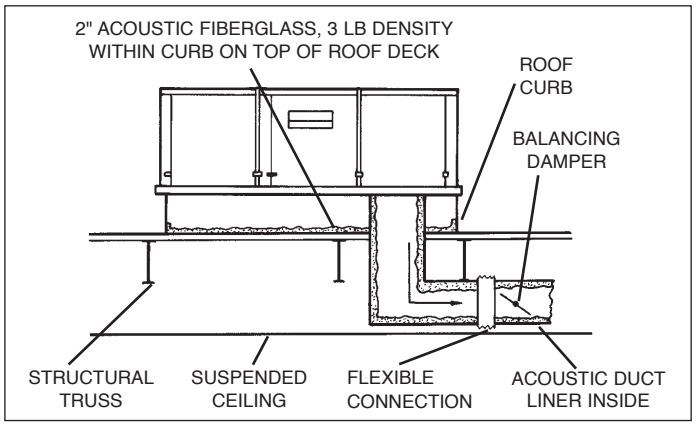


Figure 4.4 - Suggested Sound Attenuation



MOUNTING OPTIONS

Suspended Units

Combination lifting and support lugs are supplied with each unit. Units with accessory devices, such as filter sections, inlet dampers, etc., must have provisions for separately supporting these accessories. Each accessory is supplied with its own lifting and support lugs. (See Figures 4.4 and 4.5 for recommended mounting method and pages 38-41 for dimensions.)

Be sure the structure from which the unit and accessories are hung is adequate to handle the weight, which can be found on page 44. The unit must be level in a horizontal position.

Figure 4.5 - Unit Suspension (Size 110-118)

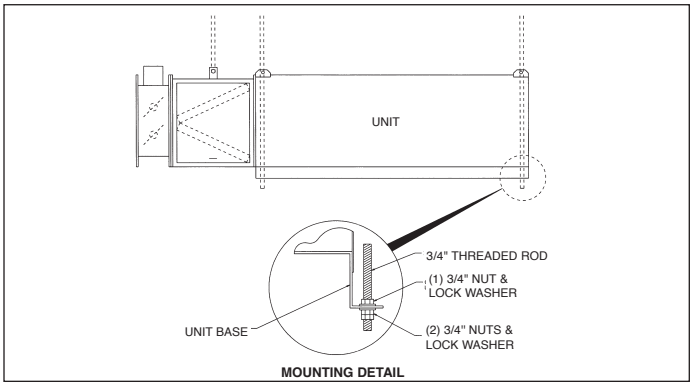
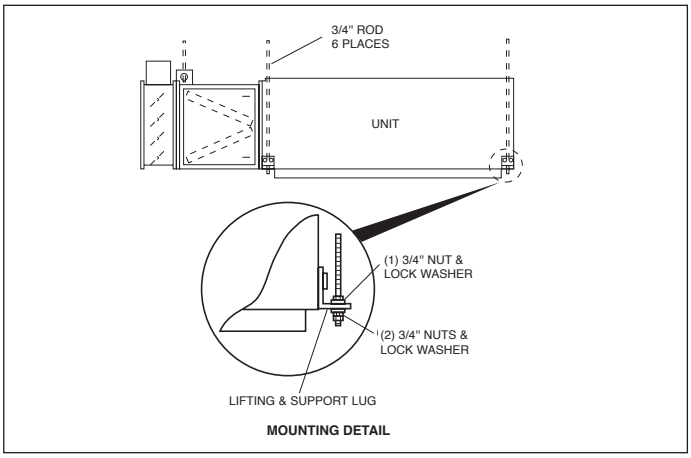


Figure 4.6 - Unit Suspension (Size 120-230)



MOUNTING OPTIONS

Rail-Mounted Units

To insure longevity and integrity of the section joints, continuous rail-mounting is required.

When rail-mounting the unit, use two continuous rails for the length of the unit (in direction of air flow), and two rails for the unit's accessories perpendicular to air flow. The unit must be level in a horizontal position.

NOTE: If V-bank filters are used with dampers, supports are required on V-bank only. If V-bank is used with inlet hood, supports are required on inlet hood only. If inlet hood is used with dampers, supports are required on inlet hood only.

Inlet hoods for all models require separate field supports.

See Figures 5.1 through 5.4 for recommended mounting methods.

Figure 5.1 - Unit Rail Supports (Size 110-118)

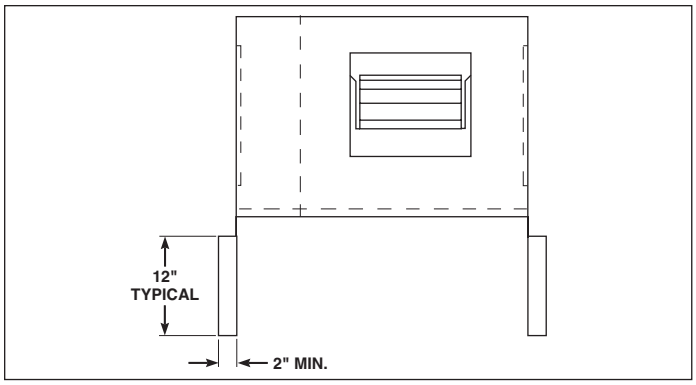


Figure 5.2 - Unit Rail Supports (Size 120-230)

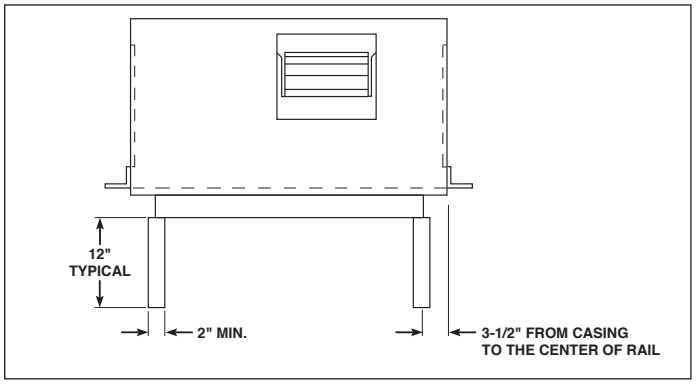


Figure 5.3 - V-Bank or V-Bank and Damper Supports

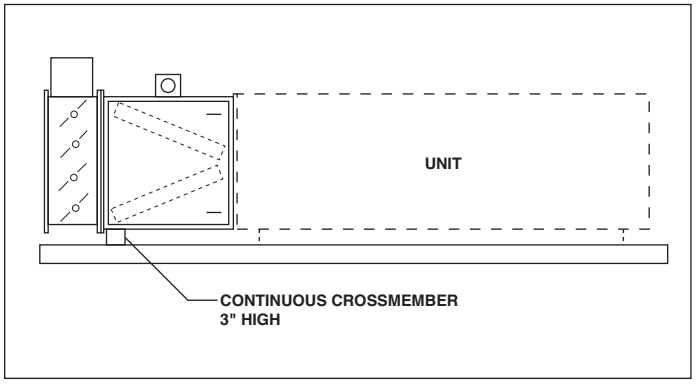
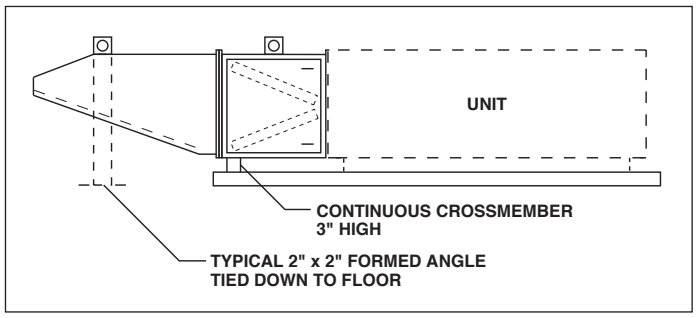


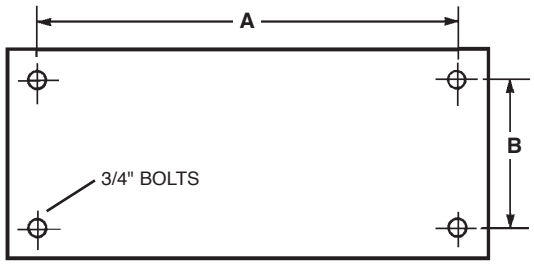
Figure 5.4 - Inlet Hood and Inlet Hood with V-Bank Supports



Slab-Mounted Units

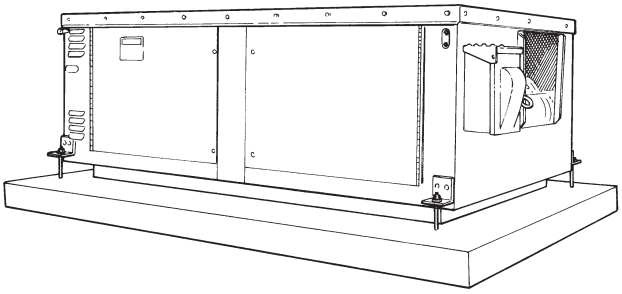
For ground level installation of the unit, prepare a level concrete slab at least 4" thick, which extends 6 inches beyond the unit on an adequate footing and a generous bed of gravel for proper drainage. The slab should include 3/4" threaded anchor bolts spaced according to Figure 5.5 for securing the unit in place. The anchor bolts should extend at least 4-1/2" above the surface of the mounting slab to allow clearance for mounting washers, bolts, and nuts (by others).

Figure 5.5 - Slab-Mounting Anchor Bolt Spacing



UNIT SIZE	A	B
110/112	45"'	68"
115/118	54"	79"
120/122	81"	93"
125-130	95"	107"
220/222	133"	93"
225/230	157"	107"

Figure 5.6 - Slab-Mounted Furnace

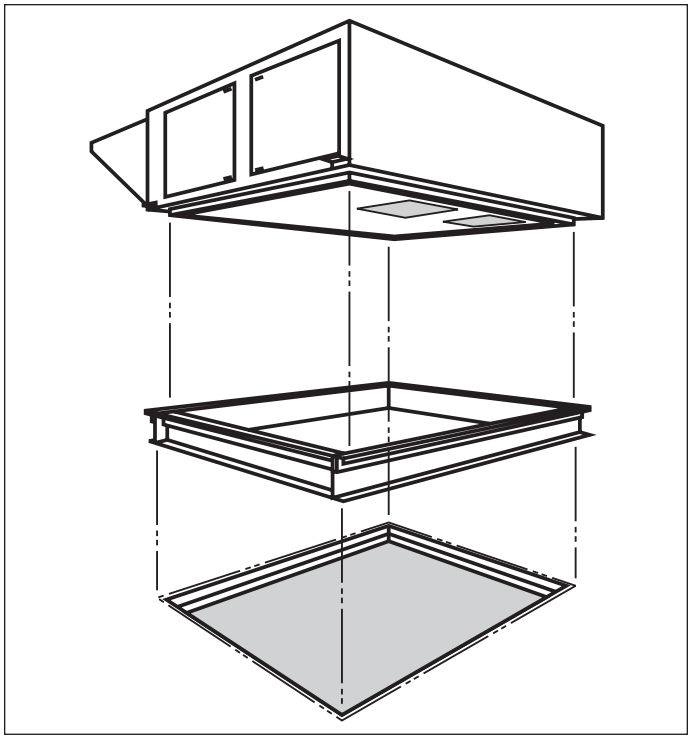


MOUNTING OPTIONS / ROOF CURB INSTALLATION

Roof Curb-Mounted Units

An optional 14" or 24" high roof curb is available to simplify site preparation and raise the unit above roof water and snow levels. It can be installed with the roof, and in advance of the unit. The curb is shipped knocked down with separate instructions for its assembly, flashing, and sealing with the roof. See page 42 for dimensions. Roof curb insulation, if required, is provided by others.

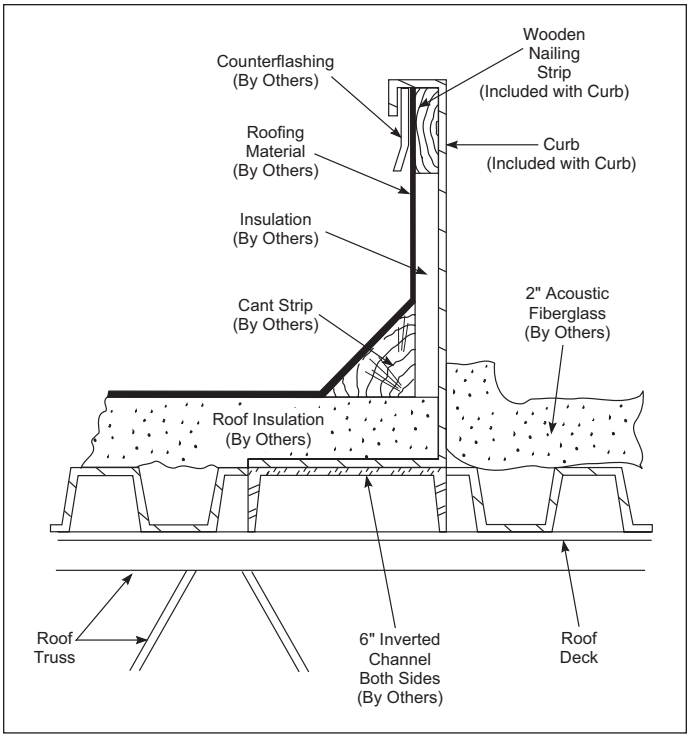
Figure 6.1 - Roof Curbs



Roof Structure

The roof structure must be adequately designed to support the live weight load of the unit and any other required support structure. For the bearing loads normally encountered, the roof curb should be supported at points no greater than five feet apart. Additional truss reinforcement should be provided, if necessary.

Figure 6.2 - Typical Curb Details with Unit Installed Over Areas where Sound is Not Critical


Wooden Nailing Strip (Included with Curb)
Counterflashing (By Others)
Roofing Material (By Others)
Curb (Included with Curb)
Insulation (By Others)
Cant Strip (By Others)
2" Acoustic Fiberglass (By Others)
Roof Insulation (By Others)
Roof Truss
6" Inverted Channel Both Sides (By Others)
Roof Deck

Roof Curb Installation

1. Roof curbs are fabricated from either 14 or 12 gauge galvanized steel, depending on the unit size, and are shipped knocked down for field assembly. The curb includes wood nailing strips, weather seal gasket, and the required nuts and bolts for assembly.
2. Outside curb dimensions must be held when installing the curb, and the top of the curb must be level to insure weather tightness. All corners must be square.
3. All dimensions have a tolerance of +/- 1/8".
4. Final electric and gas connections must be made after the unit is installed to allow for tolerance in setting of the unit on the curb. For electrical power supply, allow approximately eight feet of wire, plus provisions for weather tight flexible conduit for connection to the unit, as required by local codes.
5. Maintain an 8" minimum height from the top of the roof deck to the top of the curb.
6. Accessory items, such as hoods, inlet dampers, V-bank filters, and discharge dampers must be supported separately. (See page 5)

DUCT INSTALLATION / UTILITY LOCATION / RIGGING INSTRUCTIONS

DUCT INSTALLATION

To assure proper air flow from the discharge of the unit, follow these recommendations.

1. Be sure properly sized and designed discharge ducts are installed.
2. Units with twin blowers should have a common discharge plenum of at least three (3) hydraulic duct diameters.
3. As a general rule, all discharge ducts should have a straight run of at least three (3) hydraulic duct diameters before making turns in the ductwork.

   Hydraulic Duct Diameter for Rectangular Ducts = Dh = 4A/P

   Hydraulic Duct Diameter for Circular Ducts = Dh = D

   where: **Dh = Hydraulic Diameter**

   A = Cross Sectional Area of Rectangular Duct

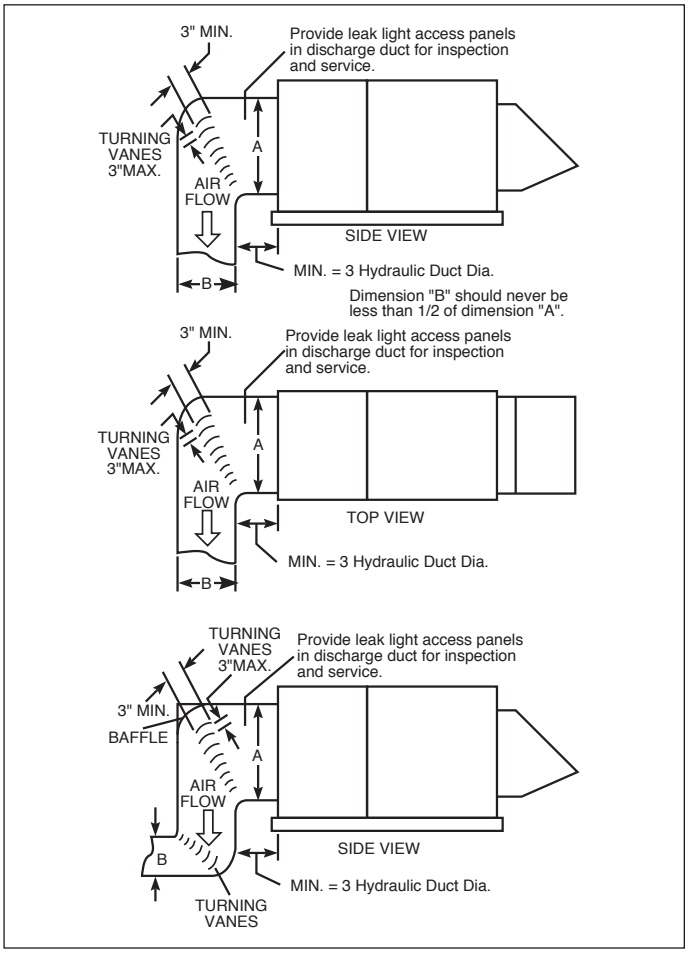
   P = Perimeter of Rectangular Duct

   D = Diameter of Round Cut

Figure 7.1 shows the recommended duct layout for various discharge ductwork. Return ducts should be designed in the same manner.

Where ductwork (or other enclosure) is installed to the inlet or outlet of the unit in such a way as to cause a possible gas trap and accumulation of a flammable mixture, a pre-purge cycle shall be incorporated to provide not less than 4 complete air changes to the ductwork (or enclosure) by volume prior to an ignition attempt.

Figure 7.1 - Recommended Field-Installed Discharge Duct Configurations



Fire Dampers

Fire dampers (supplied by others) installed in the inlet or outlet duct systems shall be provided with electrical interlocks connected in the safety limit control circuit so as to cause the heater to shut down in case of fire in the ductwork or unit. The electrical interlocks must be so arranged that the safety circuit is electrically energized only when the fire damper is in the wide-open position.

UTILITY LOCATION

Electric and control connections can be made either from the side or the bottom of the unit. The factory-supplied gas connection is located on the side of the unit. For units without factory-supplied and mounted disconnects, holes can be cut in the fixed side panels, or the bottom of the unit. Sealing of holes cut in the unit casing for utility connections should be done with care to prevent air and water leaks.

RIGGING INSTRUCTIONS

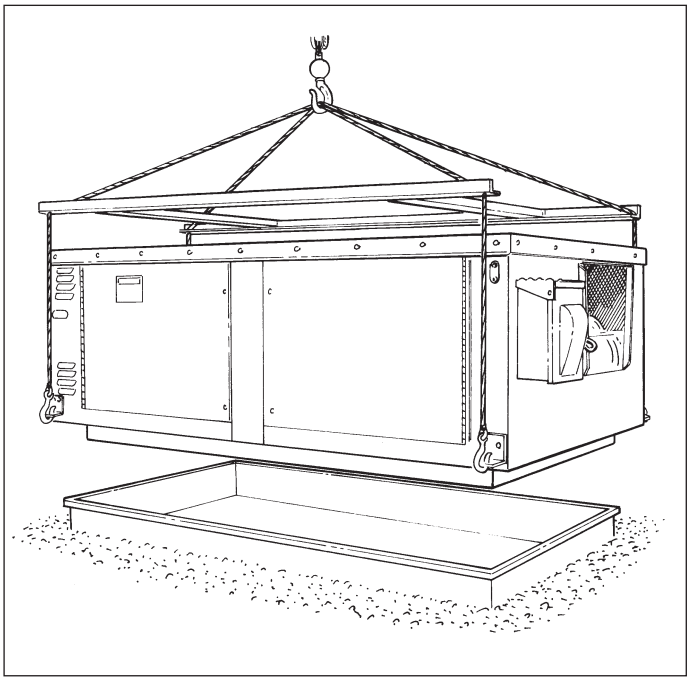
Each unit supplied with four mounting and lifting brackets with 1" clearance holes for lifting hooks.

When units are supplied with factory-mounted accessories, DO NOT use the accessory lifting eyes to support the load of the unit. The accessory lifting eyes should only be used to steady the load. The main load should be placed on the unit's lifting lugs.

For units with inlet accessories shipped separately, it is recommended that the unit and accessories be lifted separately and the accessories assembled to the unit after the unit is put into place.

The units lifting lugs are supplied at the base of the unit to provide maximum strength for lifting. **In order to lift the unit without damaging the casing, SPREADER BARS MUST BE USED!** Figure 7.2 shows the proper method for lifting the unit using spreader bars.

Figure 7.2 - Typical Rooftop Rigging



UNIT INSTALLATION

⚠ CAUTION

Do not modify burner profile opening.

Follow site preparation instructions for applicable curb, rail, or slab mounting. Check the rating plate of the unit before lifting to insure that the model number shown matches that shown on the plans. Although units may look similar, their function, capacities, options, and accessories may vary widely. Check unit dimensions for proper fit.

If the unit is mounted on a factory-supplied curb:

1. Install roof curb using previous roof curb instructions (page 6).
2. Thoroughly clean and dry the top of the curb surface.
3. Attach the factory-supplied curb gasket around the top perimeter of the curb.
4. Lift the unit into place and set the unit down evenly on curb.
5. If units are supplied with accessories for field-mounting, attach all accessories after the unit has been put into place.
6. Make final unit connections to the electric power supply and remote control circuits. Connect gas lines. Caulk all utility clearance holes on the unit after connections have been made.

If the unit is to be rail or slab-mounted, use similar directions listed under steps 4, 5 and 6.

Do not modify or block combustion or ventilation openings.

Units require field-support of the accessory inlet hood. Be sure that the accessory hood is properly supported. (See Unit and Accessory Drawings on pages 38-43).

Some models may be split-shipped to accommodate maximum shipping widths. When assembling unit sections, make sure that the sections are properly gasketed, caulked, and secured before operating the equipment.

Gas Connections

⚠ WARNING

1. All field gas supply lines should be pressure/leak tested prior to operation. Never use an open flame. Use a soap solution or equivalent for testing.
2. Gas pressure to the unit controls must never exceed the pressure shown on the unit's rating plate. The unit and its individual shutoff valve(s) must be disconnected from the gas supply during any test pressure in excess of 1/2 psig (3.5 kPa).
3. For test pressure less than 1/2 psig (3.5 kPa), the unit's gas control must be isolated from the supply gas piping by closing the unit's manual shutoff valve(s).

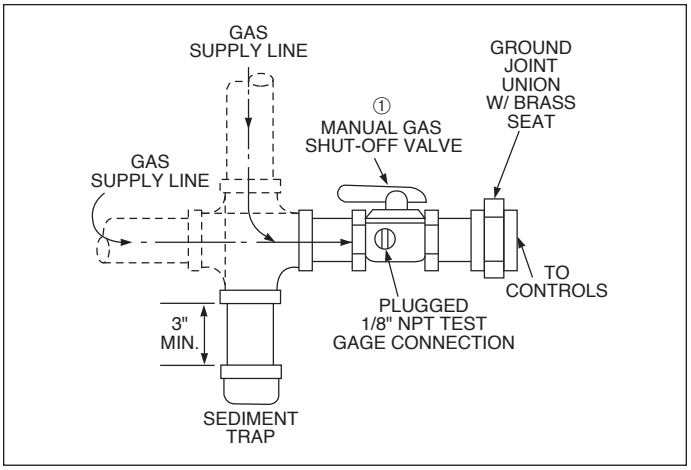
⚠ CAUTION

Purging of air from gas supply lines should be performed as described in ANSI Z223.1 - latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149 codes.

1. Installation of piping must be in accordance with local codes, and ANSI Z223.1-latest edition, "National Fuel Gas Codes". (In Canada CAN/CGA-B149 Code.)
2. Piping to units must conform to local and national requirements for type and volume of gas handled, and pressure drop allowed in the line. Refer to the unit rating plate to determine the Btu capacity of the unit and the type of gas the unit is designed to use. Using this information, refer to the ASHRAE Guide Fundamentals Handbook, or other gas pipe sizing guide, to determine the correct supply pipe size. Allow sufficient pipe size based on allowable pressure drop in supply line. Where several units are served by the same main, the total capacity of all the units served by the main must be used. Avoid pipe sizes smaller than 1/2".
3. After threading and reaming the ends, inspect piping and remove loose dirt and chips.
4. Support piping so that no strains are imposed on the unit controls.
5. Use two wrenches when connecting field piping to units.
6. Provide a drip pocket before each unit and in the line where low spots cannot be avoided. (See Figure 8.1).
7. Take-off to unit should come from top or side of main to avoid trapping condensate.
8. Piping subject to wide temperature variations should be insulated.
9. Pitch piping at least 1/4" per 15 feet of horizontal run.
10. Compounds used on threaded joints of gas piping must be resistant to action of liquefied petroleum gases.
11. Purge air from gas supply lines.
12. After air has been purged, check for gas leaks in the piping systems using a soap/water solution.
13. Install a ground joint union and gas cock external to the unit for easy servicing of controls, including a 1/8" NPT plugged tapping accessible for test gauge connections (see Figure 8.1).
14. Allow at least 5 feet of piping between any high pressure regulator and the unit control string.

Standard field gas supply connection sizes are shown in Table 8.1.

Figure 8.1 - Required Piping to Unit's Gas Controls



① Manual gas shut-off valve is in the "off" position when handle is perpendicular to pipe.

Table 8.1 - Field Gas Supply Connections

	Natural		Propane	
MBH Digit 9-12	8-14" W.C. Digit 13=A	1-5 psig Digit 13=B	11-14" W.C. Digit 13=C	1-5 psig Digit 13=D
275-400	3/4"	n/a	3/4"	n/a
550-720	1"	n/a	1"	n/a
825	1-1/4"	1"	1"	3/4"
1000	1-1/4"	1"	1"	1"
1100	1-1/4"	1-1/4"	1-1/4"	1"
1375	1-1/2"	1-1/4"	1-1/4"	1"
1650	2"	1-1/4"	1-1/2"	1-1/4"
1925-2200	2"	1-1/2"	2"	1-1/4"
2475	2-1/2"	1-1/2"	2"	1-1/4"
2750-3575	2-1/2"	2"	2"	1-1/2"
3850-4950	n/a	2"	n/a	2"
5225-7425	n/a	2-1/2"	n/a	n/a

Manifold Arrangements

⚠ WARNING

Use a dedicated line for venting gas to the outside of the building.

The standard ETL manifold arrangement is designed to meet ANSI standards and is designed for a gas inlet pressure of 8" to 14" water column. Optional 1-5 psig manifolds are available.

All Modine Manufacturing standard ETL manifold options comply to IRI safety requirements.

Controls supplied for IRI manifolds are in accordance with correspondence received from Industrial Risk Insurers dated November, 1995.

Optional manifold arrangements are available to comply with Factory Mutual (FM) requirements.

FM Manifolds

All Modine Manufacturing standard ETL manifolds up to and including 2,500,000 Btu/Hr meet FM safety control requirements.

Units required to comply with FM requirements that are selected with manifold inputs greater than 2,500,000 Btu/Hr require the selection of an optional FM manifold to satisfy FM safety requirements.

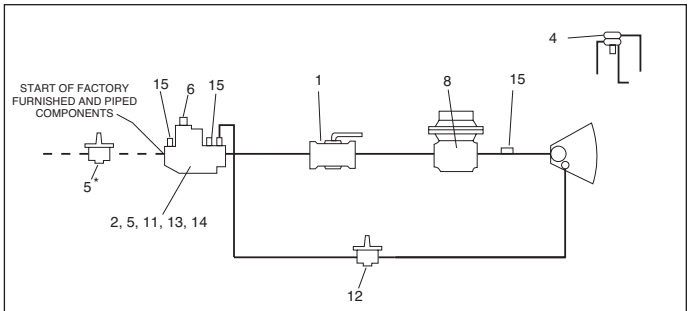
For units selected to meet FM requirements, if there is to be any form of blocked inlets in the entering air stream, such as filters or inlet dampers (potential gas traps to the outside), the optional FM with restriction manifold must be selected, regardless of Btu/Hr input. Intake screens or vertical inlet ductwork (above the unit inlet opening) are not considered blockages, while inlet dampers are considered to be blockages. The FM less restriction option may only be used when inlet restrictions do not exist.

Controls supplied for FM manifolds are in accordance with correspondence received from Factory Mutual dated November, 1995.

Table 9.1 - Component Listing for Figures 9.1 through 9.4

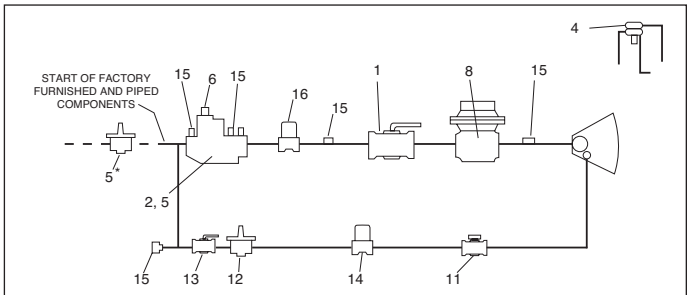
Ref.	Component
1	Auxiliary Gas Shut-Off Valve
2	Combination Main Gas Valve
3	High and Low Gas Pressure Switch
4	Main Air Flow Proving Switch
5	Main Gas Pressure Regulator
6	Main Gas Shut-Off Valve
7	Main Gas Valve
8	Modulating Valve
9	Motorized Main Gas Valve
10	N/A
11	Orificed Pilot Needle Valve
12	Pilot Gas Pressure Regulator
13	Pilot Gas Shut-Off Valve
14	Pilot Gas Valve
15	Plugged Test Port
16	Redundant Main Gas Valve

Figure 9.1 - Typical Manifold Component Arrangements Standard, IRI, & FM Arrangement - Up to 400,000 Btu/Hr



* Required and field installed when gas pressure exceeds 14" wc (1/2 psi)

Figure 9.2 - Typical Manifold Component Arrangements Standard, IRI, & FM Arrangement - Over 400,000 Btu/h and up to 720,000 Btu/Hr



* Required and field installed when gas pressure exceeds 14" wc (1/2 psi)

Figure 9.3 - Typical Manifold Component Arrangements Standard & IRI Arrangement - Over 720,000 Btu/Hr FM (Less & With Restriction) - Up to 2,500,000 Btu/Hr

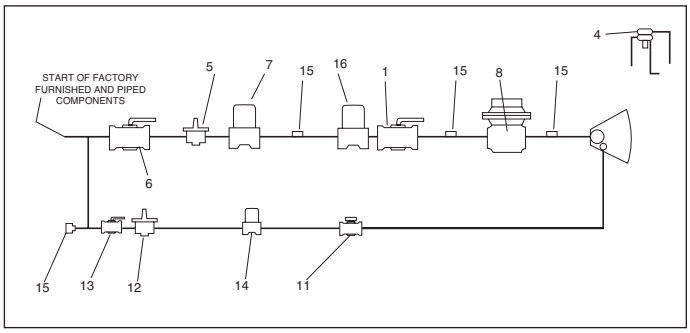
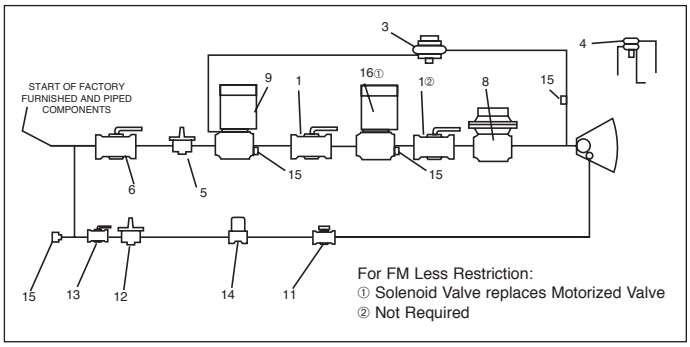


Figure 9.4 - Typical Manifold Component Arrangements FM (Less & With Restriction) - Over 2,500,000 BTU/HR



The manifold arrangements shown in Figures 9.1 through 9.4 are typical and may not match the unit supplied. Refer to the manifold piping diagram that shipped with the unit for actual arrangement.

INSTALLATION / PRIOR TO OPERATION

Electrical Connections

⚠ WARNING

1. Disconnect power supply before making wiring connections to prevent electrical shock and equipment damage.
2. All appliances must be wired strictly in accordance with wiring diagram furnished with the unit. Any wiring different from the wiring diagram could result in a hazard to persons and property.
3. Any original factory wiring that requires replacement must be replaced with wiring material having a temperature rating of at least 105°C.
4. Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% greater than rated voltage.

⚠ CAUTION

Ensure that the supply voltage to the appliance, as indicated on the serial plate, is not 5% less than the rated voltage.

1. Installation of wiring must conform with local building codes, or in the absence of local codes, with the National Electric Code ANSI/NFPA 70 - Latest Edition. Unit must be electrically grounded in conformance to this code. In Canada, wiring must comply with CSA C22.1, Part 1, Electrical Code.
2. Job specific wiring diagrams are furnished with each unit. A permanent laminated diagram is located on the inside of the electric control cabinet door. All units are supplied with a labeled terminal strip for ease of wiring. Refer to this diagram for all wiring connections.
3. Make sure all multi-voltage components (motors, transformers, etc.) are wired in accordance with the power supply voltage.
4. The power supply to the unit must be protected with a lockable fused or circuit breaker disconnect switch. If a disconnect switch is not supplied with the unit, the field supplied disconnect must have adequate ampacity and must be installed in accordance with Article 430 of the National Electric Code, ANSI/NFPA 70.
5. The power supply must be within 5% percent of the voltage rating and each phase must be balanced within 2 percent of each other. If not, advise the utility company.
6. External electrical service connections that must be installed include:
   a. Supply power connection (120, 208, 240 or 480 volts).
   b. Connection of thermostats, remote monitoring panels, building pressure sensors, time clocks, or any other accessory control devices that may be supplied (115 and/or 24 volts - refer to unit wiring diagram).
7. All outdoor electrical connections must be weatherized to prevent moisture from entering the electrical compartment. Refer to the unit dimensional drawings on pages 38 through 41 for the electrical knock-out locations.
8. All supply power electrical connections are made in the electrical section of the unit.
9. Refer to the wiring diagram for the terminal location of all wiring.

Note: If the unit is not factory supplied with an optional timed freeze protection (low-temperature system), then a low-temperature limit control must be field supplied and installed in areas where freeze protection is needed in the event of burner shutdown.

PRIOR TO OPERATION

Although this unit has been assembled and fire-tested at the factory, the following pre-operational procedures must be performed to assure the unit has not been damaged or mis-aligned during shipment. This will help assure proper on-site operation.

1. Remove all shipping straps, braces and tie downs.
2. Check burner to insure proper location and alignment.
3. Check blower and motor alignment, as well as belt tension.
4. Check bearings for alignment and tightness. Check bearing to shaft set screws for tightness.
5. Check all electrical connections for tightness.
6. Check gas piping for leaks using a soap/water solution.
7. Check gas tightness of safety shut-off valve following procedure below.

Test Procedure for Checking Gas Tightness of Safety Shut-Off Valve

1. While the unit is off, attach a pressure gauge to the downstream side of the second safety shut off valve (SSOV) closest to burner.
2. Following normal start-up procedure described in this manual, allow the burner to go to main flame.
3. Shut the unit off and let the pressure drop to zero.
4. Close hand shut-off valve immediately downstream of the second SSOV and wait 5 minutes.
5. There should be no changes in pressure. If the pressure increases, the second SSOV needs to be replaced.
6. Remove the test plug located between the two SSOV's and let the pressure to drop to zero.
7. Move the pressure gauge to the test port between the two SSOV's and wait 5 minutes. Make sure to replace the plug in the test port downstream side of the second SSOV.
8. There should be no changes in pressure. If the pressure increases, the first SSOV needs to be replaced.
9. Remove the pressure gauge and plug the test port.
10. Open the hand shut-off valve and the unit is ready for operation.

Evaporative Cooling Units

For units equipped with an evaporative cooler, refer to Installation and Service Manual - Evaporative Coolers (Literature 7-569).

After these preliminary checks have been made, the unit can be prepared for start-up.

Each unit is supplied with this Installation and Service Manual, which includes a Field Start-Up Form on page 49. The Field Start-Up Form must be followed and properly filled out by the installer, with one copy kept with the unit.

CONTROL DESCRIPTIONS

Before continuing with the start-up and checkout procedure, it is important to familiarize yourself with the controls furnished with the unit. Review the documents shipped with the unit to determine which controls are included.

The Control Definitions reference on page 48 lists all of the major safety and operating controls that may be furnished on this type of direct-fired heating equipment. The reference also defines the function of each control.

Pages 11 through 18 provide photographs and descriptions for each control. The typical locations of the electrical and gas controls are shown on pages 19 through 20. The typical locations of the blower and motor components are shown on page 25.

Once a thorough review of these controls and devices has been made, the step-by-step Start-Up Procedure as described on pages 21 through 24 must be performed.

Standard Safety Controls and Manifold

Low Air Flow Proving Switch

The low air flow proving switch monitors the pressure drop across the burner profile plate to insure that sufficient air flow exists before allowing the burner to operate. The low air flow proving switch is located in the gas controls cabinet and is electrically interlocked with the gas controls. The air flow sensing pick-up tubes run from the burner profile location back to the pressure switch. See page 19 for location.

High Air Flow Cutoff Switch

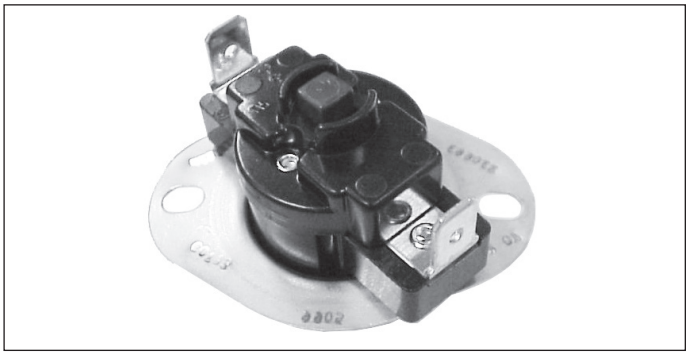
The high air flow cutoff switch monitors the pressure drop across the burner profile plate to insure that the air flow through the burner does not exceed the maximum design velocity. If the design velocity is exceeded, the gas controls will be disabled. The high air flow cutoff switch is located in the gas controls cabinet and is electrically interlocked with the gas controls. The air flow sensing pick-up tubes run from the burner profile location back to the pressure switch. See page 19 for location.

Figure 11.1 - Low Air Flow Proving/High Airflow Cutoff Switch

High Temperature Limit Control

The high temperature limit control prevents the burner from firing if excessive heated air temperatures are experienced. The limit control is mounted on the blower housing and is electrically interlocked with the gas controls. See page 25 for location. If the limit control opens a service person must inspect the unit, determine the cause, and take corrective action.

Figure 11.2 - High Temperature Limit Control



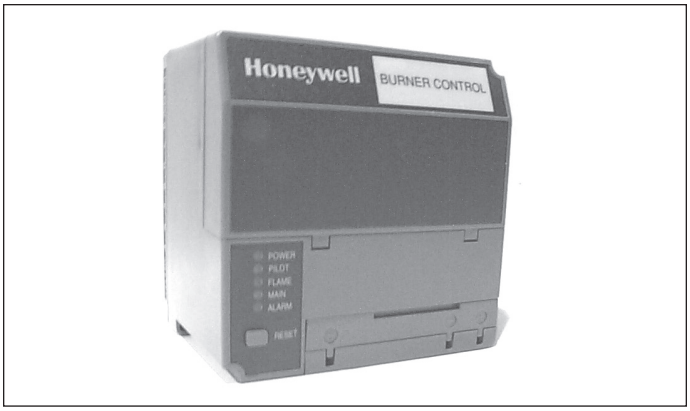
Flame Safeguard Control

All units are equipped with a flame safety control. This control senses if the pilot flame has been established through the use of a flame rod flame sensor.

The flame safeguard control has a built-in pre-purge timer, and an ignition-timing device. The pre-purge timer allows the unit to purge any residual gas in the unit before a try for ignition can take place. The pre-purge time is approximately 10 seconds. After pre-purge has occurred, the spark ignition sequence will begin. If the pilot flame is not proved within the time period allowed (10 to 25 seconds), the safeguard control will go into lockout and will have to be manually reset before a new try for ignition can occur.

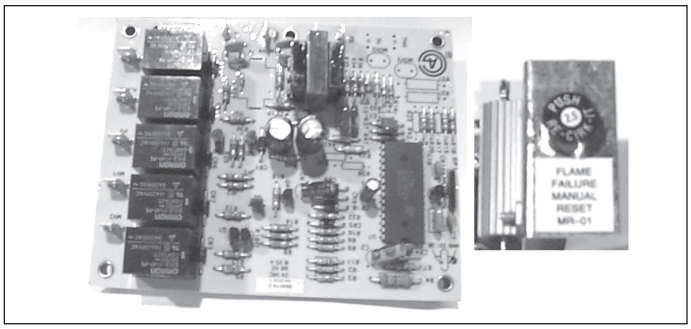
Units with burner size 720,000 Btu/h and smaller have 24V flame safeguard control (Figure 12.1). All other configurations have 115V flame safeguard control (Figure 11.3).

Figure 11.3 - Honeywell Flame Safeguard Control (115V Control Voltage)



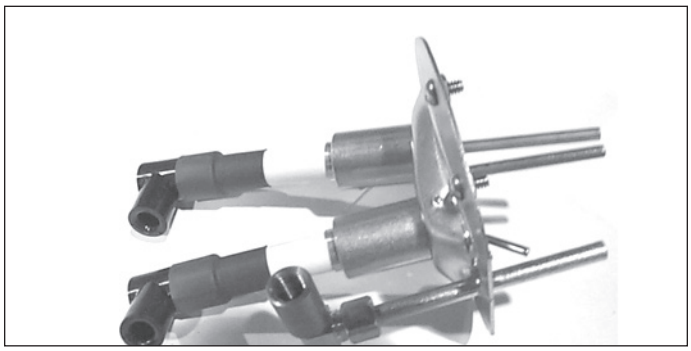
CONTROL DESCRIPTIONS

Figure 12.1 - RAM Flame Safeguard Control (24V Control Voltage)



Pilot Safety Flame Rod
A flame rod is a flame-sensing device that senses if the pilot has been established using the flame rectification principle. The flame rod monitors the pilot flame to assure it is established. If a flame is present, the flame rod will send an electrical signal to the flame safeguard control and allow ignition of the main burner.

Figure 12.2 - Flame Rod & Pilot/Ignitor Assembly



Main Burner Flame Rod
For units with burner lengths that are greater than three feet (1925 MBH or greater), the burner assembly will include a flame rod main flame sensor mounted at the burner end opposite the pilot.

Manifold Features

The type of main shutoff gas valve supplied with the unit may vary depending on whether the unit was ordered with a standard manifold or an FM or IRI manifold. To determine which valve type was supplied, see the model number of unit shipped and table 12.1.

Table 12.1 - Main Shutoff Gas Valve Type

MBH Digit 9-12	Insurance Digit 15	Main Shutoff Gas Valve Type
Up to 720	1, 2 or 3	(1) Combination redundant gas valve
Over 720 to 2,500	1, 2 or 3	(2) Solenoid gas valves
Over 2,500	1	(2) Solenoid gas valves
Over 2,500	2	(1) Solenoid and (1) motorized gas valve
Over 2,500	3	(2) Motorized gas valves

Digit 15:
1=ETL/IRI
2=FM less Restriction
3=FM with Restriction

Main Solenoid Gas Valve
All units are supplied with redundant automatic main gas shut-off valves. These valves may be in the form of a combination gas valve (having two valve seats in one valve body) or two separate valves. The solenoid gas valves are electrically operated and allow gas flow to the unit's modulating gas valve. See pages 19-20 for locations.

Figure 12.3 - Combination Gas Valve

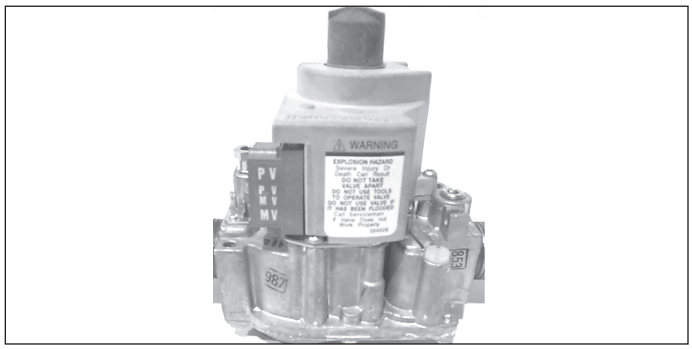
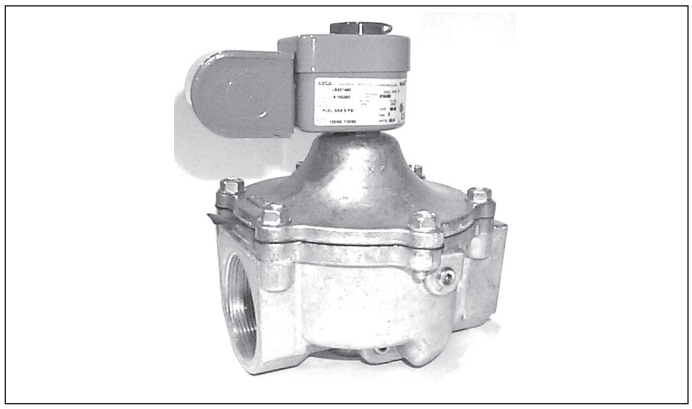


Figure 12.4 - Single Solenoid Gas Valve



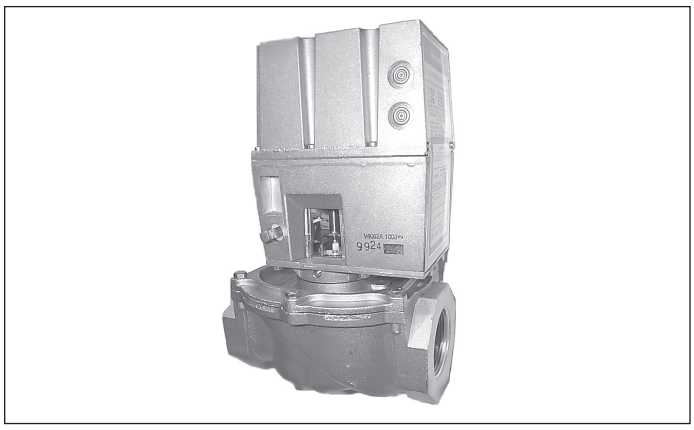
CONTROL DESCRIPTIONS

Main Motorized Gas Valve

FM (and some local codes) may require the use of one or two motorized main gas shut-off valves in lieu of the standard solenoid valves, depending on the input capacity of the burner. See manifold arrangements on page 9 for manifold component listing.

The motorized valve uses a hydraulic pump to open the valve and includes a heavy-duty self-closing return spring for positive shut-off in the event of a power loss to the valve.

Figure 13.1 - Motorized Main Gas Valve



Pilot Gas Solenoid Gas Valve

The pilot solenoid gas valve serves as a separate shut-off valve for the pilot gas. See pages 19-20 for locations.

Combination High/Low Gas Pressure Switch

When required by local codes, a combination high/low gas pressure switch can be added to the unit controls. The switch monitors the gas pressure downstream from the safety gas shut-off valves in the case of high gas pressure, and ahead of all of the automatic gas valves in the case of low gas pressure. The gas pressure safety switches will shut off all electric power to the gas safety shut-off valves if excessive (high pressure switch) or low gas pressure (low pressure switch) is experienced. A combination high/low gas pressure switch is standard for FM manifolds over 2500MBH (Digit 9-12>2500 and Digit 15=2 or 3). See Table 13.1 for additional details.

Figure 13.2 - High/Low Gas Pressure Switch

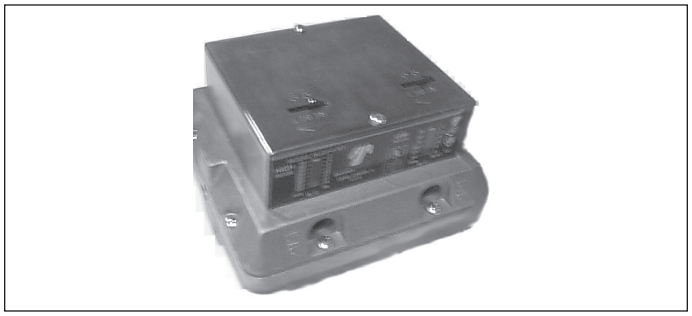


Table 13.1 - Gas Pressure Switch Type

MBH	Insurance	
Digit 9-12	Digit 15	Gas Pressure Switch(es)
Up to 720	1, 2 or 3	Optional per Digit 16
Over 720 to 2,500	1, 2 or 3	Optional per Digit 16
Over 2,500	1	Optional per Digit 16
Over 2,500	2	Standard High and Low
Over 2,500	3	Standard High and Low

Digit 15:
1=ETL/IRI
2=FM less Restriction
3=FM with Restriction

Digit 16:
C and G=High and Low Gas Pressure Switches

Modulating Temperature Controls

Units are supplied with Maxitrol modulating temperature controls and gas valve.

Depending on the type of gas and temperature controls ordered with the unit, one or more of the following devices will be used. Check the unit's model number to determine which type of temperature controls were supplied.

Maxitrol Modulating Gas Valve

Controlled by the Maxitrol Modulating Valve control amplifier, the valve is modulated to control the flow of gas to the burner. See pages 19-20 for locations.

Figure 13.3 - Maxitrol Modulating Control Gas Valve

Maxitrol Modulating Valve Control Amplifier

The Maxitrol amplifier converts the temperature control signal from the discharge air temperature sensor (and room temperature sensor if Max 44 is used) and modulates the gas control valve to maintain the air temperature at the sensor's set-point temperature.

Figure 13.4 - Maxitrol Modulating Valve Control Amplifier

CONTROL DESCRIPTIONS

MAXITROL System 14

Discharge Air Temperature Control

System 14 is an electronic modulating discharge air temperature control system with a remote temperature dial for adjusting the discharge air temperature set point. A field mounted and wired discharge air sensor monitors the discharge air temperature and controls an electronic modulating gas valve which modulates the main burner gas flow to maintain the desired discharge air temperature. The temperature set point range for this system is 55-90°F.

The discharge air sensor is mounted in the junction box at the end of the mixing tube. The air mixing tube is then field-mounted in the discharge air duct with the air inlet holes of the mixing tube facing the discharge air from the unit. (see page 18, figure 18.2).

The accessory System 14 Remote Panel must be used. The System 14 Remote Panel includes a remote Temperature Set Point Dial, a Summer/Off/Winter Selector switch, a Main Valve On light and a Flame Failure Alarm light (see figure 14.2).

This system may be used with an accessory room temperature override thermostat. Upon a call for heat from the room override, the stat automatically overrides the discharge air temperature setting by 15°F to provide warmer discharge air until the room override stat is satisfied.

For return air units, model MRB, depending on design conditions, this control may be acceptable, but requiring additional control devices with the system. Also included are a factory installed/set return air stat and a factory installed/set outside air stat. If the temperature sensed falls below the setpoint for either stat, the unit will go to 100% outside air mode until both stats are satisfied. Please refer to the Gas Control Selection Table 15.1 on page 15 for additional guidance.

Figure 14.1 Discharge Air Sensor with Mixing Tube

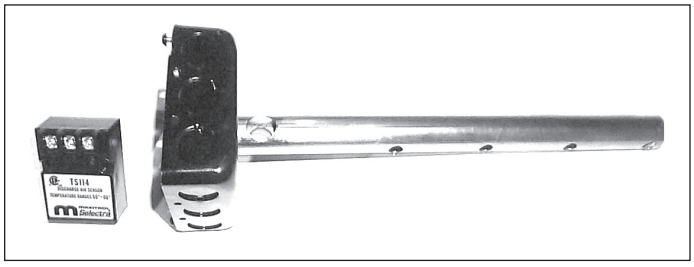


Figure 14.2 - Remote Temperature Dial for Maxitrol 14

MAXITROL System 44

Space Temperature Control

System 44 is an electronic modulating room temperature control system, which utilizes a Selectra-Stat modulating room thermostat to control the main burner firing rate based on the room air temperature set point. The stat monitors the room space temperature and sends a signal back to the control amplifier to modulate the gas control valve to maintain proper space set-point temperature. The temperature set point range for this system is 55-90 degrees F.

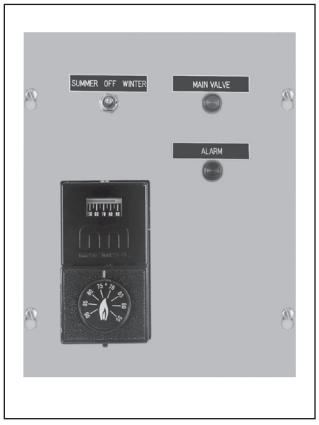
This control system also includes a field mounted and wired discharge air sensor, which is used as a high and low temperature limit control. The discharge air sensor will prevent make-up air from being delivered to the space at temperatures below the low setpoint, even if the room thermostat is satisfied. It will also prevent the room thermostat from over firing the burner when mild outdoor temperatures exist and the maximum firing capacity of the burner is not required to achieve an appropriate discharge air temperature.

When specifying this control system, the accessory System 44 Remote Panel must be used. The System 44 Remote Panel includes an electronic Modulating Room Thermostat, a Summer/Off/Winter selector switch, a Main Valve On light and a Flame Failure Alarm light (see Figure 14.3).

For return air units, model MRB, depending on design conditions, this control may be acceptable, but requiring additional control devices with the system. Also included are a factory installed/set return air stat and a factory installed/set outside air stat. If the temperature sensed falls below the setpoint for either stat, the unit will go to 100% outside air mode until both stats are satisfied. Please refer to the Gas Control Selection Table 15.1 on page 15 for additional guidance.

The Selectra-Stat is used in conjunction with a discharge air sensor and air mixing tube. The discharge air sensor serves to limit the minimum and maximum discharge air temperature from the unit.

Figure 14.3 - Room Stat for Maxitrol 44



CONTROL DESCRIPTION

DDC Compatible Controls

Building Management Control (4-20mA or 0-10VDC)

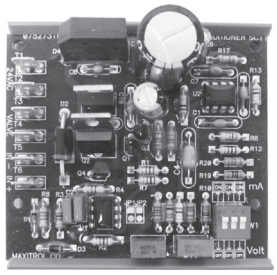
The DDC compatible control system is an electronic modulating control system, which utilizes a 4-20mA or 0-10VDC input signal (by others) to control the discharge air temperature. This system is available on MDB units only.

This system requires a field supplied air temperature sensor that is compatible with the building management system. This sensor is wired to the building management system and based on the temperature reading from that thermostat, the building management system will increase or decrease the signal to the makeup air unit gas controls. An increase or decrease in the input signal modulates the main burner gas flow to maintain the desired discharge air temperature.

Provided with this system is a factory installed discharge air sensor which is used as a high temperature limit control. The discharge air sensor will prevent make-up air being delivered to the space that is above the maximum operating limit of 105°F.

For return air units, model MRB, depending on design conditions, this control may be acceptable, but requiring additional control devices with the system. Also included are a factory installed/set return air stat and a factory installed/set outside air stat. If the temperature sensed falls below the setpoint for either stat, the unit will go to 100% outside air mode until both stats are satisfied. Please refer to the gas Control Selection Table 15.1 for additional guidance.

Figure 15.1 - Maxitrol SC11 Signal Conditioner



Gas Control Selection Table for Model MRB Units

Table 15.1 is to be used for Model MRB units only to determine applicability of the various available gas control systems to meet requirements of ETL certification and ANSI Z83.18. For additional information on these control systems, please see Gas Control Descriptions above.

Table 15.1 - Gas Control System Selection Table for Model MRB

Gas Control System	RA/OA Ratio	Minimum Outside Air Temperature (per ASHRAE) ①	Maximum Discharge Air Temperature	Room Override
Maxitrol 14	75/25	-30°F and Above	90°F	Not Available
	70/30	-30°F to Lower than 10°F		
	70/30	10°F and Above	90°F ②	Accessory
Maxitrol 44 or Maxitrol SC11	75/25	-30°F to Lower than -10°F	90°F	Not Applicable
		-10°F to Lower than 0°F	95°F	
		0°F and Above	100°F	
	70/30	-30°F to Lower than -20°F	95°F	
		-20°F to Lower than -10°F	100°F	
		-10°F and Above	105°F	

① Minimum return air temperature is 55°F. For return air temperatures below 55°F, please contact the factory.
② Room override accessory can override discharge air setting by 15°F to a maximum discharge air temperature of 105°F.

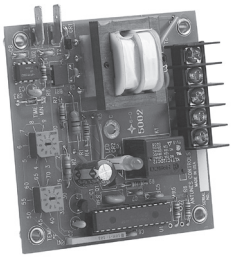
OPTIONAL CONTROLS

Timed Freeze Protection

(Mounted in electrical control cabinet when furnished)

An optional timed freeze protection system can be supplied with the unit. This system includes an electronic solid state timing board, and a discharge air temperature sensor. When power is supplied to the unit and the fan is energized, the timed delay relay allows the unit to go through the normal ignition sequence. The time delay relay is set to engage the discharge air temperature sensor after a period of 3 minutes. In the event the unit fails to fire and deliver heated air during the 3-minute timing period, the discharge air sensor will sense the cold air and will shut down the entire unit.

Figure 16.1 - Timed Freeze Protection Control



Mild Temperature Inlet On/Off Stat

(Mounted in piping compartment when furnished)

An optional mild temperature On/Off inlet stat may be supplied with the unit. The purpose of the mild temperature On/Off stat is to shut the main burner off 100% during mild weather so undesirable temperature build-up in the space will not occur.

Figure 16.2 - Mild Temperature Inlet On/Off Stat

Variable Frequency Drive (VFD)

(Shipped separately for field mounting by others)

Variable air volume 100% Make-Up units are equipped with a VFD. The VFD controls the speed of the blower motor to vary the air flow (cfm) from 100% to 30% of the full rated air flow. The VFD is controlled by either a two-speed interlock, building pressure control or a building management system.

Figure 16.3 - Variable Frequency Drive

Photohelic Building Pressure Control

(Optional for VFD equipped MDB Units or 75/25 MRB units)

The control includes a photohelic pressure switch with pressure gauge, an outdoor air pressure pick up tube and a pick-up tube wind and rain shield kit. Return air units also include an outside air burner bypass damper linked to a return air damper and a floating damper motor to control the mixture of outside and return air.

The purpose of the control is to sense the difference between the indoor building pressure and the outdoor atmospheric pressure. This system is used when one make-up air unit handles varying exhaust loads. As more exhaust fans are turned on, pressure in the building will tend to become negative. The photohelic pressure switch senses this change in pressure and controls the unit operation to bring in more outside air to bring the building pressure back to near atmospheric.

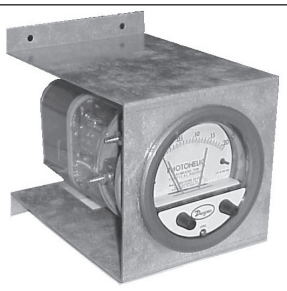
For MDB units, the VFD will vary the motor speed between 30% and 100% of the rated airflow for the selected unit. For MRB units, the floating damper motor adjusts the position of the outside air bypass damper and return air damper to vary the outside air/return air ratio from a minimum 25% outside air (75% maximum return air) to 100% outside air (0% return air). The damper motor is a non-spring return type motor so when power is interrupted to the motor via the photohelic pressure switch, the motor will remain in its current position.

Note: The building pressure control's low pressure tap must be vented to the outdoors and fitted with the wind and rain shield provided with the photohelic control.

Adjusting the pressure adjusting knobs on the face of the pressure gauge sets the desired building pressure set point range. The smaller the difference between the high and low pressure needles, the more sensitive the setting will be. The larger the difference, the less sensitive the setting.

Figure 16.4 - Photohelic Building Pressure Control

(Shipped separately for field mounting by others)

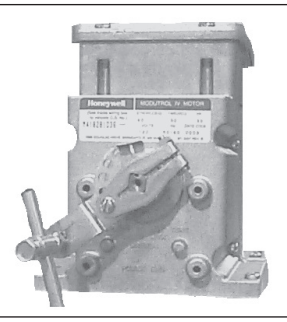


Inlet or Discharge Outside Air Shut-Off Dampers

If an optional inlet or discharge outside air shut-off damper is supplied with the unit, the damper will include an electric damper operator motor. The motor is connected to the damper blades via damper linkages. The damper operator motor includes a damper motor end switch that is interlocked with the unit's blower motor and burner controls. The burner and blower controls cannot operate unless the damper motor end switch has closed.

Figure 16.5 - Damper Operator Motor

(Mounted on inlet or discharge outside air damper)



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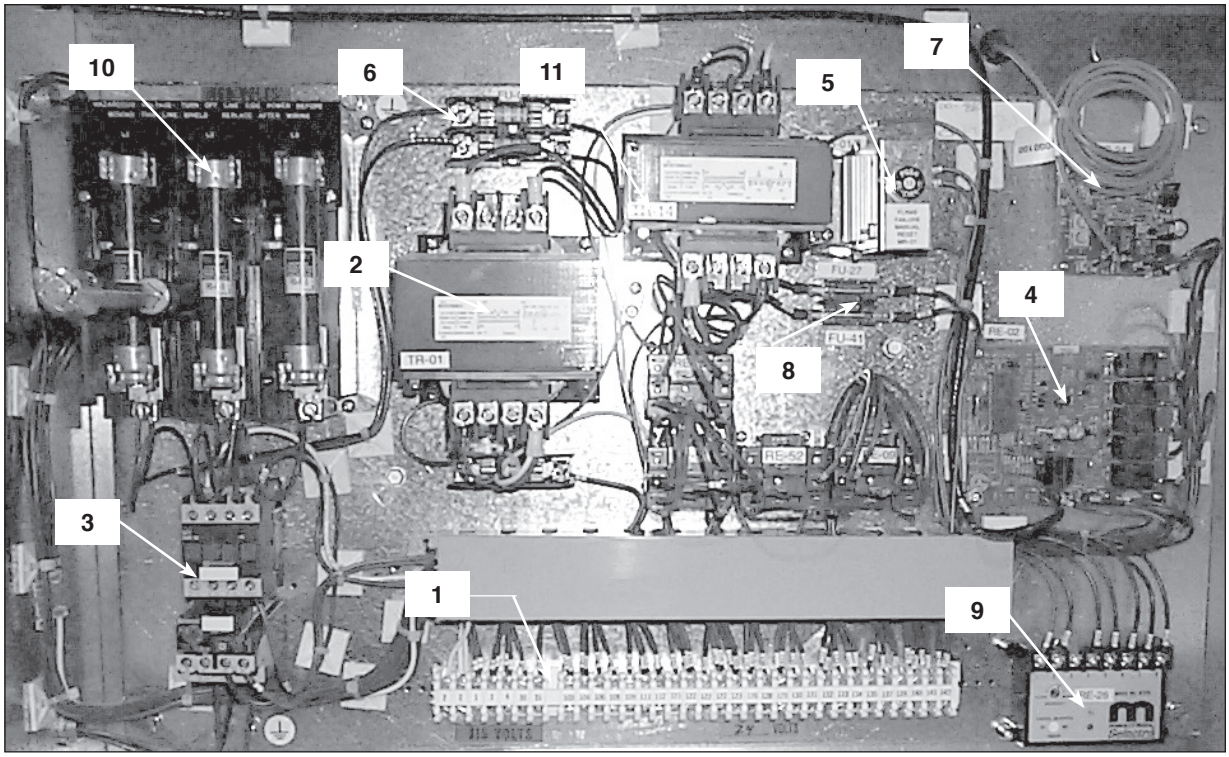
PRIOR TO OPERATION

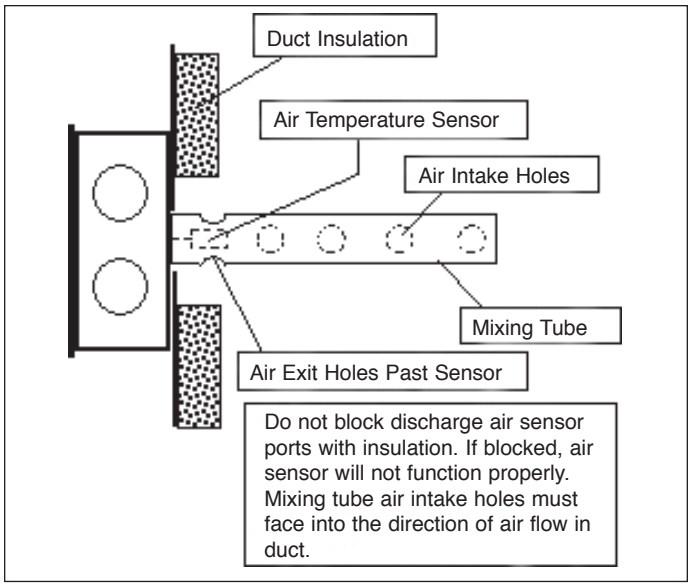
Controls Locations

Figure 18.1 - Electrical Control Cabinet (Maxitrol System 14 shown)



1. Field Wiring Terminal Strip
2. 115V Control Transformer
3. Motor Starter
4. RAM Flame Safeguard Relay
5. RAM Flame Safeguard Manual Reset Button
6. Control Circuit Fuses
7. Freeze Protection Relay (Optional)
8. Low Voltage Control Circuit Fuses
9. Maxitrol Modulating Valve Amplifier
10. Dead Front Disconnect Switch (Optional)
11. 24V Control Transformer

Figure 18.2 - Maxitrol System Discharge Air Sensor
(Must be field-installed and wired in a single perimeter supply duct, not to exceed 20 feet downstream of unit.)


Duct Insulation
Air Temperature Sensor
Air Intake Holes
Mixing Tube
Air Exit Holes Past Sensor
Do not block discharge air sensor ports with insulation. If blocked, air sensor will not function properly. Mixing tube air intake holes must face into the direction of air flow in duct.

PRIOR TO OPERATION

Figure 19.1 - Piping Control Cabinet - Typical Control String Through 400 MBH

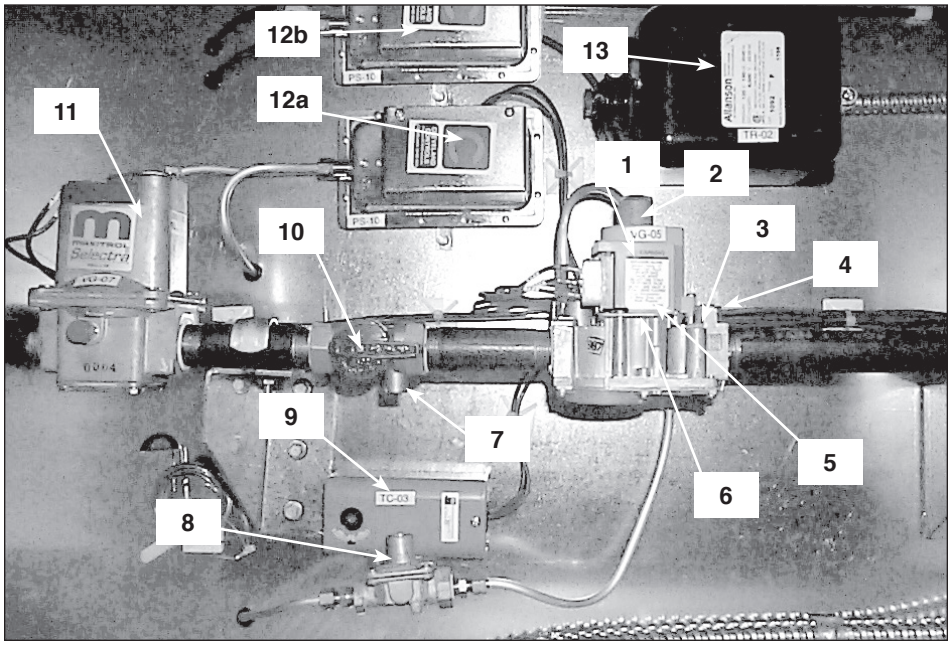
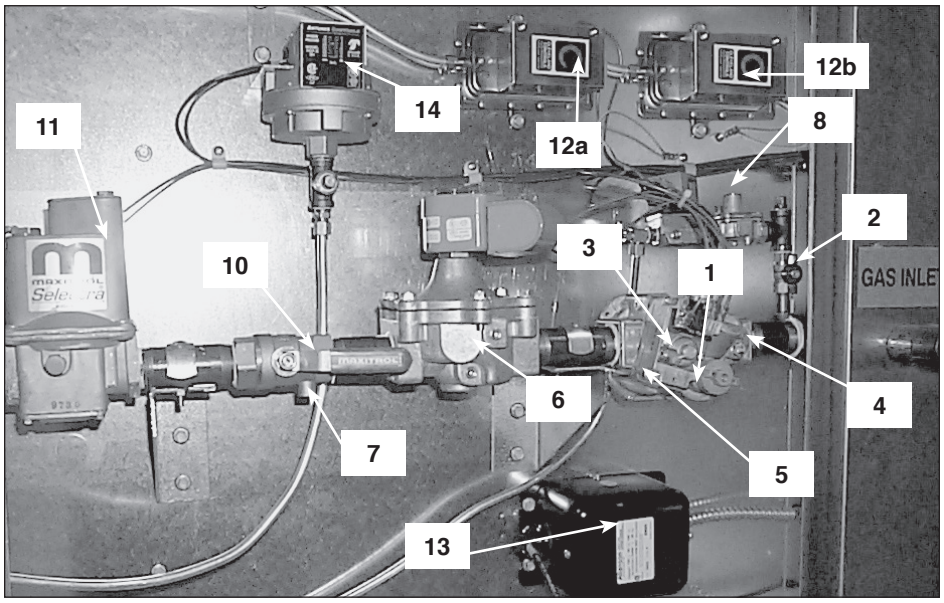


Figure 19.2 - Piping Control Cabinet - Typical Control String Over 400 MBH Through 720 MBH



1. Main Gas Hand Shut-Off Valve
2. Pilot Gas Hand Shut-Off Valve
3. Main Gas Regulator
4. Inlet Gas Pressure Test Port
5. Main Gas Solenoid Valve
6. Redundant Main Gas Solenoid Valve
7. Mod. Valve Inlet Gas Pressure Test Port
8. Pilot Gas Regulator
9. Optional Inlet On/Off Stat
10. Mod. Valve Hand Shut-Off Valve
11. Modulating Main Gas Valve
12.a Low Air-Flow Proving Switch (PS-10)
12.b High Airflow Cutoff Switch (PS-11)
13. Ignition Transformer
14. Optional Gas Pressure Switch

The piping arrangements shown are typical and may not match the unit supplied. Refer to the manifold piping diagram and wiring diagram that shipped with the unit for actual arrangement.

PRIOR TO OPERATION

Control Locations (continued)

Figure 20.1 - Piping Control Cabinet - Typical Control String 720 Through 1000 MBH

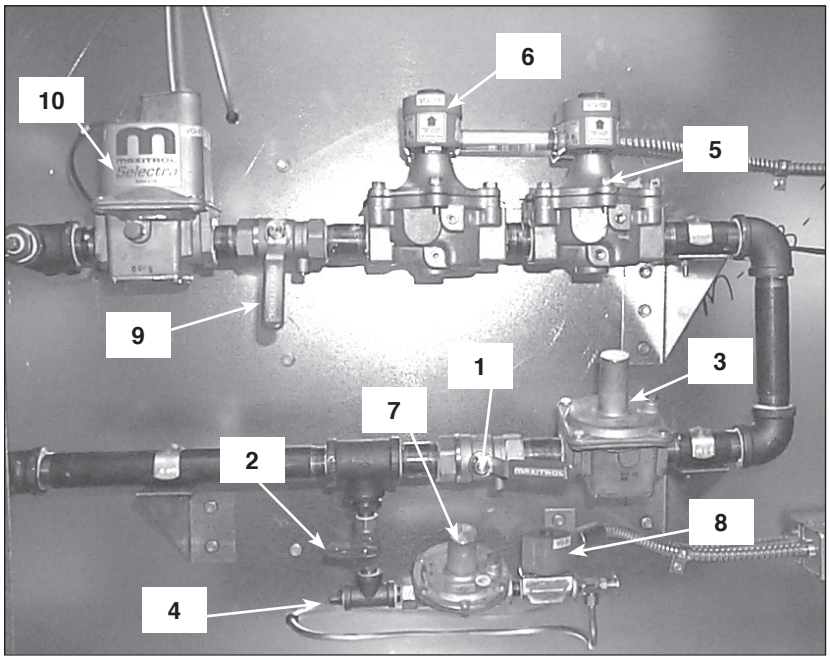
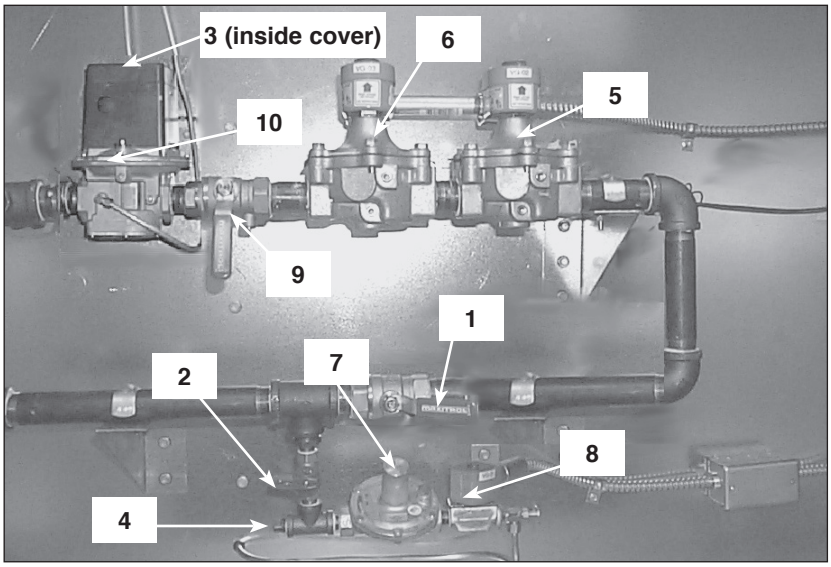


Figure 20.2 - Piping Control Cabinet- Typical Control String Over 1000 MBH



1. Main Gas Hand Shut-Off Valve
2. Pilot Gas Hand Shut-Off Valve
3. Main Gas Regulator
4. Inlet Gas Pressure Test Port
5. Main Gas Solenoid Valve
6. Redundant Main Gas Solenoid Valve
7. Pilot Gas Regulator
8. Pilot Gas Solenoid Valve
9. Mod. Valve Hand Shut-Off Valve
10. Modulating Gas Valve

The piping arrangements shown are typical and may not match the unit supplied. Refer to the manifold piping diagram and wiring diagram that shipped with the unit for actual arrangement.

START-UP PROCEDURE

Start-Up Procedure

⚠ CAUTION

1. Do not operate unit with a gas input rate greater than that shown on the unit's rating plate.
2. Purging of air from gas supply lines should be performed as described in ANSI Z223.1 - latest edition "National Fuel Gas Code", or in Canada in CAN/CGA-B149 codes.

IMPORTANT

Start-up and adjustment procedures should be performed by a qualified service agency.

To properly perform the start-up, the following instruments are required.

Volt Meter (25-600 volt)

Amp Meter (0-100 amp)

Micro-Amp Meter (0-20 mAmp)

Ohm Meter

Gas Pressure Gauge (Range dependent on inlet pressure to unit)

Slack Tube Manometer, or 0-30" w.c. Pressure Gauge

Inclined Manometer (0-5" w.c.)

Hand Held Tachometer (contact, reflective, or strobe type)

After the unit has been installed and the preliminary checks have been made, the following start-up must be performed.

1. Turn off all power to the unit. Turn all hand gas valves to the closed position.
2. Set the optional Summer/Off/Winter switch on the remote control panel to the "Off" position, and set all stats to their lowest settings.
3. Check to see that there are no obstructions to the inlet air supply or the discharge air supply ducts (and return air unit openings).
4. Check to see that all wiring is secure and properly connected and protected.
5. Recheck belt tension and pulley alignment. (See Page 25)
6. Check bearings for proper lubrication. (If the unit has been supplied with spider bearings, the bearings are permanently lubricated and do not require additional lubrication.)
7. Check to make sure that all air filters are in place, and that they are installed properly according to direction of air flow.
8. Perform a visual inspection of the unit to make sure no damage has occurred during installation. Make sure all service doors have been replaced and/or closed.
9. With the optional Summer/Off/Winter switch still in the "Off" position, turn on the electric supply to the unit.
10. Move the optional Summer/Off/Winter switch to the "Summer" position. The inlet and/or discharge outside air damper (if supplied) should open. When they are in the full open position, the damper motor end switch should make and allow the blower motor to operate.
11. Check to make sure that the inlet and/or discharge damper (if supplied) opens properly without binding.
12. Check the blower for proper direction of rotation.
13. Check the blower speed (rpm). For units equipped with a VFD, blower speed should be checked at both high and low speeds. (See page 25 for motor and blower adjustment).
14. Check the motor speed (rpm). For units equipped with a VFD, motor speed should be checked at both high and low speeds.
15. Check the motor voltage (for units equipped with a VFD, the voltage should be checked at high speed). On three phase systems, check to make sure all legs are in balance.
16. Check the motor amp draw (for units equipped with a VFD, the amp draw should be checked at high speed) to make sure it does not exceed the motor nameplate rating. On three phase systems, check all legs to insure system is in balance.
17. Recheck the gas supply pressure by installing a gas pressure gauge connected to the inlet gas pressure test port. See figure 9.1 trough 9.4 on page 9 to locate the inlet gas pressure test port. Refer to rating plate for proper gas supply pressure to unit. If inlet gas pressure exceeds the maximum pressure specified on the rating plate, a gas pressure regulator must be added upstream of the factory furnished and piped components.

    Refer to the heater rating plate for determining the minimum gas supply pressure for obtaining the maximum gas capacity for which this heater is specified.
18. Check pilot and pilot ignition. For this step, open the pilot gas hand valve only.
19. Check to make sure that all manual reset safety devices have been reset to their normal operating position.

    Note: If high and/or low gas pressure switches have been supplied, the first main gas hand valve will also have to be opened at this time. However, the second main gas hand valve located before the modulating gas valve should be kept in the closed position.
20. Set the Summer/Off/Winter switch to the "Winter" position and move the temperature controls to call for heat.

    Note: If a mild temperature inlet On/Off stat has been supplied the set point of the stat may have to be adjusted to allow initiation of the pilot ignition sequence. If this is necessary, raise the set point of the inlet stat.
21. Check to see that the pilot lights properly.

    The spark ignitor should begin to spark in approximately 10 seconds, and the pilot flame should be established within 10 seconds.
22. Check for proper signal output for the pilot safety control.

    The unit has been supplied with a flame rod sensor. The output signal from the sensor should be stable and in accordance with the flame safeguard manufacturer's recommended signal strength.

    For units with a Honeywell flame safeguard control the signal should be between 3-5 Vdc (Min. of 1.25 Vdc, Max. of 5 Vdc).

    For units with a RAM flame safeguard control, the output signal should be between 2-3 Amps. (See supplier's literature for signal test connections and recommended signal strength of flame safeguard controls.)

    Adjust the pilot regulator and/or pilot line orificed needle valve up or down if the pilot signal reading is outside of the manufacturer's specified range.

START-UP PROCEDURE

Start-Up Procedure (continued)

23. Check to make sure the flame sensor and flame safeguard relay is operating correctly.

    To check, shut off the pilot gas hand valve while the pilot is still lit. The pilot flame should go out and the pilot ignitor should try for re-ignition within 2 to 4 seconds. Because the pilot gas is off, and the pilot cannot be re-established, the flame safeguard control should go into lockout. (If the flame safeguard control does not go into lockout, see separate vendor literature shipped with the unit for trouble shooting and corrections.)

24. Turn the pilot gas hand valve to the on position and reset the flame safeguard relay using the flame safeguard manual reset button. Allow the unit to re-establish the pilot.

25. The burner profile velocity pressure differential must be checked after installation, with all accessories and ductwork installed, to assure correct air velocity across the burner. Check the pressure differential across the profile plate using an inclined manometer per the following:

    a. Remove the factory installed plastic tube connectors from the aluminum air pressure differential pick-up tubes, between the aluminum pickup tubes and the tee connection before the low airflow proving switch (PS-10) and high airflow cutoff switch (PS-11). Slide the inclined manometer tubes over the ends of the aluminum pickup tubes.

    b. The low airflow proving switch (PS-10) must be jumped out of the circuit during this test. To jumper the switch, place a jumper wire on the unit terminal strip to which the switch is wired. For units with 24V flame safeguard controls, the typical terminals are 21 and 40. For units with 115V flame safeguard controls, the typical terminals are 105 and 134. For additional information on identifying the flame safeguard control voltage and appropriate terminals, see both page 11 of this manual and the job specific wiring diagram supplied with the unit. Note that the jumper wire must be removed after completing this test.

    c. The test is to be run with the unit operating (blower running) in the 100% outdoor air mode. For units equipped with a VFD, the unit must be running at high speed.

    d. If the outdoor air temperature is below 60°F, fire the main burner to achieve a discharge air temperature of approximately 70°F. If the burner does not fire under these conditions, refer to the Service and Troubleshooting Table 46.1, Section E for additional guidance. If the outdoor temperature is 60°F or greater, do not fire the main burner.

    e. Read the pressure differential reading on the manometer and compare against the required value in Table 22.1. Note that the pressure differential reading is dependent on the elevation above sea level for which the unit is installed and must be within +/- 0.05"W.C.

       For example, for a MRB unit installed at 4500 feet above sea level, with a 70°F discharge air temperature, the profile pressure differential should be 0.50"W.C. The actual installed pressure differential reading must be 0.50"W.C. +/- 0.05"W.C., or 0.45"W.C. to 0.55"W.C.

Table 22.1 - Profile Pickup Tube Pressure Drop

Model Configuration			"W.C. by Elevation Above Sea Level (ft)						
Model	Gas Type	Variable Frequency Drive (VFD) Included?	0-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-7500
MDB	Natural	No	0.47	0.42	0.41	0.39	0.38	0.36	0.36
		Yes	1.41	1.27	1.22	1.18	1.13	1.09	1.07
	Propane	No	0.60	0.54	0.52	0.50	0.49	0.46	0.46
		Yes	1.80	1.62	1.56	1.50	1.47	1.38	1.38
MRB	Natural or Propane	N/A	0.60	0.54	0.52	0.50	0.49	0.46	0.46

    f. If the required differential cannot be achieved, the blower speed may have to be adjusted. Refer to page 25 for blower adjustments.

       For example, if the required burner velocity pressure differential should be between 0.45"W.C. and 0.55"W.C. and the actual reading is less than 0.45", the blower speed will have to be increased. If the actual reading is greater than 0.55" the blower speed will have to be reduced.

       Note: Whenever the blower speed is changed, the motor amp draw must be rechecked to assure that the motor does not become overloaded.

    g. When the correct burner velocity pressure differential is achieved, turn the unit off and open the main disconnect switch. Remove replace the tubing removed in Step (a) and the low airflow pressure switch jumper that was added in Step (b).

Steps 26-30 must be performed on HIGH SPEED if unit is equipped with a VFD.

26. Turn on the main gas hand valve(s).

27. Observe low fire flame to make sure it lights across the entire length of the burner, is stable, and is burning with a clean blue flame.

28. Adjust the manifold pressure to maximum firing rate shown on the rating plate (See Maxitrol supplier literature) and observe the high fire flame. Make sure that it is stable, and is burning clean. (A slight orange tip may be evident and is acceptable.)

29. Check the burner gas pressure at high fire to make sure the unit is not over fired. See piping diagram furnished with the unit for pressure tap locations. (See unit rating plate for high fire burner pressure setting.)

30. After the high fire pressure has been checked and reset if necessary, turn the temperature controls down to their lowest setting and recheck the low fire burner flame. It should still be stable and burning clean.

    Recycle the ignition sequence to make sure the burner lights off smoothly and the gas lights across the entire length of the burner.

START-UP PROCEDURE

Start-Up Procedure (continued)

31. Check the gas input rate.

    Gas pressure regulators supplied by the factory and already installed to the gas piping manifold are factory adjusted for average conditions. Regulators shipped separately require field adjustment. In either case, it is important to check to make sure that the gas supply pressure to the unit is in accordance with the input pressure rating shown on the unit's serial plate. Check the gas supply pressure at the unit, upstream from the unit's pressure regulator.

    Actual input rate should be checked and necessary adjustments made after the unit is installed. Over-firing, a result of too high an input pressure, can result in poor combustion and undesirable levels of products of combustion being introduced into the heated space.

    Over-firing also reduces the life of the equipment and can increase maintenance. Under no circumstances should the input exceed that shown on the unit's rating plate.

    The actual input rate can be checked by the meter timing method providing no other gas equipment connected to the gas meter is operating during the test, otherwise use the manifold pressure method (see section B).

    The following procedures describe how the two gas input checks are accomplished.

A. Meter Timing Method

1. Determine the design gas flow rate to the burner. The flow rate can be calculated as follows:

   Gas Flow Rate (cu. ft./hr) = Unit Input Btu/hr / C

   Where C is the calorific value of gas. Typical calorific values are shown in Table 23.1. The actual calorific value of gas can be obtained from the local gas utility or gas dealer.

   Table 23.1 - Typical Calorific Gas Values (sea level)

Gas Type	Btu/cu. ft.
Natural	1050
Propane	2500

   Example:

   Natural gas unit with input rating of 525,000 Btu/hr. The gas flow rate is:

   525,000 Btu/hr / 1050 Btu/cu.ft = 500 cu. ft./hr

2. Determine the time, in seconds, required to consume 1 cu. ft. of gas. The time can be calculated as follows:

   seconds/cu. ft. = 3600 seconds/hr / Gas Flow Rate

   Example:

   From previous example, calculated Gas Flow Rate = 500 cu. ft./hr. Time to consume 1 cu. ft. of gas is:

   3600 seconds/hr / 500 cu. ft./hr = 7.2 seconds

3. Shut off all other gas-burning equipment, including other gas pilots served by the gas meter.
4. Start the unit and count the number of seconds it takes to consume 1 cu. ft. of gas.

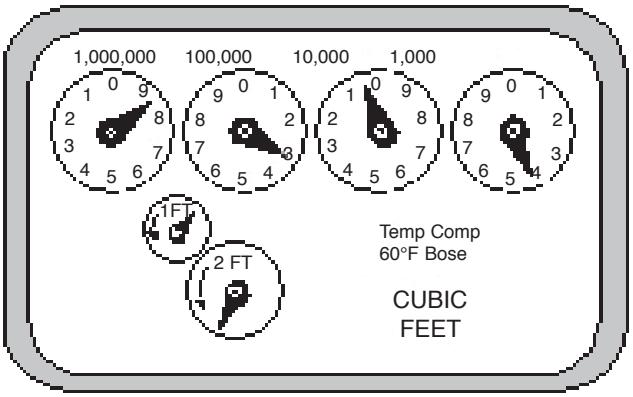
   If the seconds for 1 cu. ft. of gas are more (input less) than calculated for the unit being tested, remove the cap from the pressure regulator and take one clockwise turn at a time on the adjustment screw until the correct time is obtained. If the seconds are less (input greater) than required, follow the same procedure in a counterclockwise direction. Never remove the adjustment screw from the regulator.

   If the correct number of seconds cannot be obtained, contact your factory sales representative.

   Note: Depending on the type of meter being used, the meter may or may not have a 1 cu. ft. meter dial. If it does not, simply multiply the time calculated for 1 cu. ft. of gas flow (in seconds) by the dial size being used.

   For example, a 0.5 cu. ft. dial will take .5 x 7.2 seconds, or 3.6 seconds for one complete revolution. A 2 cu. ft. dial would take 2 x 7.5 seconds, or 14.4 seconds to complete one revolution.

Figure 23.1 - Typical Gas Meter Dial



B. Pressure Method

The pressure method determines input by measuring the pressure of the gas in the manifold in inches of water column.

1. Close the main gas manual hand valve.
2. Remove the 1/8" pipe plug test port at the burner and attach a water manometer or "U" tube that is at least 12" high.
3. Open the main gas manual hand valve and start the unit.
4. If pressure as indicated by the "U" tube is not more than 1/2" higher or lower than indicated on the unit's rating plate, adjust gas valve regulator to the setting on the unit's rating plate per the regulator vendor's instructions shipped with the unit.

   If the pressure indicated by the "U" tube is more than 1/2" higher or lower than indicated on the unit's rating plate, check the inlet gas pressure to the unit. Adjust the main gas supply regulator to supply the correct gas inlet pressure to the setting shown on the unit's rating plate.

Start-Up Procedure (continued)

Multi-Speed and Return Air Units

Units with VFD's or return air options require the following additional start-up checks.

Two-Speed Units (VFD)

1. Check the motor and blower speed at both high and low speed.
2. Check motor amps at both high and low speed.

VFD Building Pressure Control

Check to make sure the building pressure control is operating properly. The building pressure control is designed to decrease or increase motor and blower speed as building pressure increases or decreases.

To check if this is occurring, turn on an exhaust fan and observe the motor speed. The motor speed should increase. The VFD display will also indicate that the frequency (Hz) is increasing. With all exhaust fans operating (maximum exhaust fan load), the VFD will continue to increase blower speed toward full speed to meet the building pressurization requirements.

Return Air Units (Not available in Canada)

70/30, 75/25 Return Air Units

1. Check to make sure that the outside air burner by-pass damper and return air damper operate correctly and without binding.
2. Check the position of the by-pass and return air damper based on the mode of operation in Table 24.1.

75/25 Building Pressure Control Return Air Units

(Not available in Canada)

1. Check to make sure that the outside air burner by-pass damper and return air damper operate correctly and without binding.
2. Check to make sure the building pressure control is operating correctly.

The building pressure control is designed to change the position of both the outside air and return air-mixing dampers as the pressure in the building increases or decreases.

To check if this is occurring, turn on an exhaust fan and observe the return air damper position. It should start to close. Turn on additional exhaust fans. The return air damper should close further.

With all of the exhaust fans operating (maximum exhaust load) the return air damper should be in the fully closed position, and the burner by-pass damper should be in the fully open position (see Table 24.1).

Table 24.1 - Outside Air Bypass - Return Air Damper Positions

Mode	Damper Positions	
	By-Pass Damper	Return Air Damper
100% Outside Air	Open	Closed
With Return Air	Closed	Open

Final Step

After all of the initial start-up procedures have been performed, the unit is ready for commissioning. Set the temperature controls for automatic operation if the unit is to be put into service immediately. If the unit is to be left for stand-by operation, set the optional Summer/Off/Winter switch to the "Off" position and turn the electric power to the unit off at the unit's disconnect switch.

START-UP PROCEDURE

Blower/Motor Adjustment

Most units are supplied with adjustable drive sheaves. Some large motor sizes may be supplied with with fixed drives. All units are supplied with an adjustable motor mounting plate.

Follow electrical connections for supplying power to the motor. Check for the proper blower rotation. The correct direction of rotation is marked on the blower housing. Start blower and check blower speed (rpm) using a hand-held tachometer (strobe-type, or reflective-type tachometer are preferred types). Rpm of blower should match the speed (rpm) shown on the unit's rating plate.

For units with adjustable drives adjust the blower using the following procedure if the measured blower speed does not closely match the rpm's shown on the rating plate.

1. Loosen motor base and take belt(s) off of the motor sheave.
2. Loosen set screw(s) on the outer side of the adjustable motor sheave.
3. To speed up the blower, turn the outer side of the drive sheave clockwise to close the pulley. To slow the blower speed, turn the outer side of the adjustable sheave counterclockwise to open the pulley.
4. Retighten motor sheave set screw(s) and replace belt. Motor base may have to be shifted to obtain proper belt tension. The proper belt tension is achieved when there is a 3/4" deflection of the belt when a force of approximately 5 pounds is applied to the center of the belt. DO NOT OVER TIGHTEN! (see Figure 25.2).
5. Recheck blower speed after adjustment.
6. Check motor amps to make sure the actual motor amp draw does not exceed the motor nameplate amp draw.

For units with fixed drives, the rpm of the blower has been factory preset to achieve the correct speed based on the job conditions specified at the time the unit was ordered. If proper air flow and/or blower speed can not be obtained, contact the factory for alternate drive selections.

When adjusting belt tension, it is recommended that a belt tension gauge be used. Set gauge for 5 lbs. pressure and test at center of belt (half way between motor and blower sheaves. (See Figure 25.2 below). The proper belt tension is achieved when there is a 3/4" deflection.

Figure 25.2 - Belt Tension Adjustment

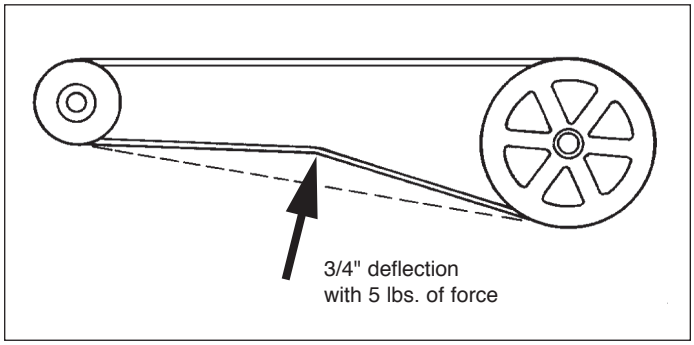
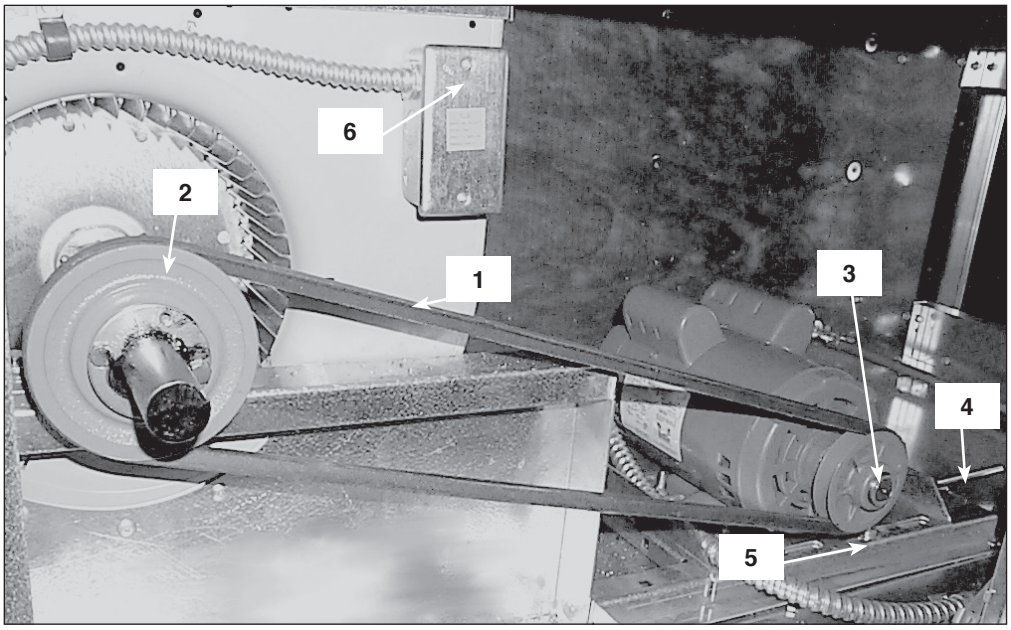


Figure 25.1 - Blower and Motor Drive Assembly



1. Drive Belt
2. Blower Sheave
3. Motor Sheave
4. Belt Tension Adjusting Screw
5. Motor Base Fastening Bolts
6. High Temperature Limit Control

START-UP PROCEDURE

Sequence of Operation

Figure 26.1 - Typical Remote Control Panel
(Shipped separately for mounting by others)

Remote Switch in "Off" Position

With the Summer/Off/Winter switch in the "Off" position, the unit is shut down and neither the blower nor the burner will operate.

Remote Switch in "Summer" Position

With the remote switch in the "Summer" position, the following sequence of operation will occur.

Note: If freeze protection is furnished with the unit, the freeze protection timer will be energized at this time to provide power to the inlet and/or discharge damper motor (if furnished with unit).

1. The inlet and/or discharge air damper motor is energized.
2. When the damper is fully open, the internal damper motor end switch will make and allow power to be supplied to the blower motor or blower motor starter.
3. The gas controls and temperature controls are locked out to prevent heating during the "Summer" mode of operation.

Remote Switch in "Winter" Position

With the remote switch in the "Winter" position, the following sequence of operation will occur.

Note: If freeze protection is furnished with the unit, the freeze protection timer will be energized at this time to provide power to the inlet and/or discharge damper motor (if furnished with unit).

1. The inlet and/or discharge air damper motor is energized.
2. When the damper is fully open, the internal damper motor end switch will make and allow power to be supplied to the blower motor or blower motor starter.
3. Air flow pressure switch proves (closes) and allows power to be supplied to the flame safeguard sequence enabling circuit. Power is supplied through the normally closed high temperature limit(s) control contact. (Blower light is lit if supplied)
4. After 10 seconds of pre-purge time, the flame safeguard ignition sequence is energized, the pilot ignitor is energized, the pilot valve is opened, and the pilot is lit. (If the following optional controls are supplied, the power to the flame safeguard is routed through the high and/or low gas pressure switch(s), mild temperature inlet On/Off stat, motorized proof of closure valve, and timed freeze protection relay.)
5. After the pilot is lit and proved, the main gas valves are energized and the burner fires at low fire. The main valve "on" light is lit.
6. Burner remains on low fire momentarily, then the temperature controls take over and fire the burner based on load demands.

Note: If the unit has been supplied with a dirty filter switch, the filter light will come on only if the pressure drop across the filters becomes excessive.

If a flame failure should occur, the flame failure alarm light on the remote panel will light. The flame safeguard relay will go into the lockout mode. The flame safeguard must be reset manually in order to restart the unit (reset button is located in the electrical cabinet of the unit). Before resetting, a service person must inspect the unit, determine the cause, and take corrective action.

CONTROL APPLICATIONS - 100% Makeup Air Units - Model MDB

Tables 27.1 through 27.3 show the sequence of operation for 100% Makeup Air Two Speed and VFD Airflow Control Options and associated Control Types. Note that in all cases, the controlling thermostat is based on the gas controls selected and the firing rate control is not controlled by the night setback thermostat. For additional information on gas controls options, please see page 13-16.

Table 27.1 - Two Speed VFD Control Types

Control Type "A" - Manual High/Low Speed Switch			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Low	Continuous - Low	100% OA (50% CFM)①	Per Gas Controls
High	Continuous - High	100% OA (100% CFM)①	Per Gas Controls
Control Type "B" - High/Low Speed Exhaust Fan Interlocks			
# of Exhaust Fans Operating Operation	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
0	Off ②	None	Per Gas Controls
1	Continuous - Low	100% OA (50% CFM)①	Per Gas Controls
2	Continuous - High	100% OA (100% CFM)①	Per Gas Controls

① If used with the Two Speed VFD Airflow Control Option, the VFD low speed is factory set for a speed between 30% and 100% as specified by the customer. If VFD low speed is 50% of high speed, then either fan can start the unit. If the low speed is higher or lower than 50% of high speed, it is critical that the exhaust fans always be started in the same order.

Table 27.2 - VFD with Building Pressurization Controller Control Types

Control Type "A" - Continuous Operation			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
None (power on)	Continuous	100% OA (30-100% air volume)	Per Gas Control
Control Type "B" - Manual Occupied/Unoccupied Switch with Night Setback Stat			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Occupied	Continuous	100% OA (30-100% air volume)	Per Gas Controls
Unoccupied	Intermittent ②	100% OA (30% air volume)	Per Gas Controls (Enabled by Night Setback Stat)
Control Type "C" - Time Clock with Night Setback Stat			
Time Clock Mode	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Occupied	Continuous	100% OA (30-100% air volume)	Per Gas Controls
Unoccupied	Intermittent ②	100% OA (30% air volume)	Per Gas Controls (Enabled by Night Setback Stat)

Table 27.3 - VFD Building Management (DDC) System Control Types

Control Type "A" - 4-20mA Building Management Control System Analog Signal			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Unit enabled by contact closure from DDC system ②	Continuous	100% OA (30-100% air volume)	Per Gas Controls
Control Type "B" - 0-10VDC Building Management Control System Analog Signal			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Unit enabled by contact closure from DDC system ②	Continuous	100% OA (30-100% air volume)	Per Gas Controls

Note: The VFD varies the speed of the motor to provide between 30% and 100% of the total unit airflow, based on the analog signal received from the building management system.

② A separate inlet or discharge air damper is required if 100% shut-off of outside air is required when the unit is not operating.

CONTROL APPLICATIONS - Return Air Units - Model MRB

Tables 28.1 through 28.2 show the sequence of operation for Return Air Two-Position and Floating Airflow Control Options and associated Control Types. Note that in all cases, the controlling thermostat is based on the gas controls selected and the firing rate control is not controlled by the night setback thermostat. For additional information on gas controls options, please see page 13-16.

Model MRB units feature outside air bypass and return air dampers and either a two-position damper actuator or a floating damper actuator with a remote mounted room to outside air photohelic pressure controller. The function of the dampers are as follows:

- As the outside air bypass dampers are opened and the return air dampers closed more outside air is introduced to the building (less return air).
- As the outside air bypass dampers are closed and the return air dampers opened less outside air is introduced to the building (more return air).

The maximum return air is based on the Return Air/Outside Air ratio selected. Available ratios are 75/25 or 70/30.

Table 28.1 - Two Position (75/25 or 70/30 Return Air/Outside Air Ratio) Control Types

Control Type "A" - Manual Occupied/Unoccupied Switch			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Occupied	Continuous	100% OA	Per Gas Controls
Unoccupied	Continuous	Minimum OA	Per Gas Controls
Control Type "B" - Manual Occupied/Unoccupied Switch with Night Setback Stat			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Occupied	Continuous	100% OA	Per Gas Controls
Unoccupied	Intermittent ①	Minimum OA	Per Gas Controls (Enabled by Night Setback Stat)
Control Type "C" - Time Clock with Night Setback Stat			
Time Clock Mode	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Occupied	Continuous	100% OA	Per Gas Controls
Unoccupied	Intermittent ①	Minimum OA	Per Gas Controls (Enabled by Night Setback Stat)

Table 28.2 - Floating Position Outside Air Bypass and Return Air Dampers for Building Pressurization Control Types

Control Type "A" - Continuous Operation			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Delivery Thermostat**
N/A	Continuous	Floating 25% to 100% OA	Per Gas Controls
Control Type "B" - Manual Occupied/Unoccupied Switch with Night Setback Stat			
Changeover Switch Setting	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Occupied	Continuous	Floating 25% to 100% OA	Per Gas Controls
Unoccupied	Intermittent ①	25% OA, 75% RA	Per Gas Controls (Enabled by Night setback Stat)
Control Type "C" - Time Clock with Night Setback Stat			
Time Clock Mode	**Blower Operation**	**Air Delivery**	**Controlling Thermostat**
Occupied	Continuous	Floating 25% to 100% OA	Per Gas Controls
Unoccupied	Intermittent ①	25% OA, 75% RA	Per Gas Controls (Enabled by Night Setback Stat)

① A separate inlet or discharge air damper is required if 100% shut-off of outside air is required when the unit is not operating.

GENERAL PERFORMANCE DATA

Table 29.1 - General Performance Data ① ②

Model Size	Min CFM (All Units)	Model MDB Units		Model MRB Units	
		Max CFM	Max Input Btu/hr ③	Max CFM (75/25) ④	Max CFM (70/30) ⑤
110	1,600	3,300	432,400	3,000	3,000
112	2,000	4,700	615,800	4,380	4,500
115	3,000	6,500	851,700	6,000	6,000
118	3,500	10,000	1,310,300	6,190	6,630
120	6,000	13,500	1,769,000	12,000	12,000
122	8,000	16,500	2,162,100	12,980	13,900
124	10,000	21,500	2,162,100	n/a ⑤	n/a ⑤
125	10,000	21,500	2,817,300	20,000	20,000
127	12,000	26,000	3,406,900	23,260	24,000
130	14,000	30,000	3,931,100	23,260	24,920
220	18,000	27,000	3,538,000	25,345	26,000
222	25,000	33,000	4,324,200	25,345	27,155
225	30,000	46,000	6,027,700	38,685	41,450
230	36,000	60,000	7,862,200	38,685	41,450

① See blower performance data on pages 34-35 for available total static pressure drop capability.

② ETL certified maximum allowable discharge air temperature is 105°F. Maximum air temperature rise is 115°F for Natural Gas, 100°F for LP Gas.

③ Maximum Btu/hr based on max CFM and temp rise with -30°F entering air. Actual max Btu/hr may be lower depending on job conditions.

④ CFM shown is with -10°F outside air with a 100°F air temperature rise. Actual capability may vary with different conditions. Please refer to the AccuSpec software with your conditions.

⑤ Model Size 124 is available only for 100% outside air applications.

UNIT SELECTION

Selection Procedure

In order to properly select a direct-fired heating, ventilating, cooling or make-up air unit, it is necessary to have the following basic information.

1. **Required air handling capacity (CFM).**
   The air capacity of the unit is usually determined by the ventilation air requirements, exhaust load of the building, infiltration losses, or the air turns/changes of the space.
2. **Outdoor and indoor design temperature.**
   The outdoor design temperature is determined by using the ASHRAE Guide design temperatures for the city where the equipment is to be installed. For heating and ventilating units, the desired room temperature would be used as the indoor design temperature. In the case of 100% make-up air units, the discharge air temperature should be at least equal to the temperature of the air being exhausted.
3. **Required heating input capacity (Btu/Hr).**
   The heating input capacity of the unit is determined by using the formula (for sea level): BTU/hr = CFM x Temp Rise (°F) x 621 / (460 +Discharge Temp)
4. **External static pressure to unit.**
   The external static pressure (E.S.P.) is determined using the ASHRAE Guide for duct losses, or may be provided by the design engineer.
5. **Unit configuration with options and accessories (Rainhood, filters, dampers, or evaporative cooler).**
   The unit configuration is determined by the location where the unit is to be installed. The critical options and accessories are those that add internal static pressure (I.S.P.) to the unit. Once these items are determined, the pressure drop curves would be used to calculate the total pressure drop (T.S.P.)

   Total Static Pressure = Internal + External Static Pressure
6. **Type of fuel and gas pressure**.
   Either natural or propane gas determined by the design engineer.
7. **Temperature control method.**
   Either discharge, room or DDC compatible control as determined by the design engineer.
8. **Main power supply voltage to unit.**
9. **Altitude at which unit is to be installed.**

With this information a basic unit can be selected as shown in the following example.

Selection Example - 100% Make Up Air

Select an outdoor, slab mounted, direct-fired, 100% make-up air unit, FM insurance option, with vibration isolation to meet the following:

1. CFM at sea level = 6,000 cfm
2. Outdoor design temp = 10°F, Discharge temp = 70°F
3. Heating input capacity = 6000 cfm x (70°F -10°F) x 621 / (460 + 70) = 421,810 Btu/Hr
4. External Static Pressure = 0.74"W.C.
5. Right hand controls, airflow is to blow down into building. The following accessories are to be included: 2" Permanent Filters, Rainhood and Discharge Damper
6. Gas Type = Natural gas, 8-14" W.C. supply pressure.
7. 0-10VDC building management control is required.
8. Supply Voltage: 460V/60Hz/3Ph. Altitude: 1000 feet

With the information listed above, the basic model, using the Model Nomenclature shown on page 51, can be selected as shown in the following example:

1. **Determine the Product Type (Digit 2):**
   The Product Type for 100% make up air is D.
   Digit 3 represents an internal design sequence and is always B. Digits 1-3 = MDB.
2. **Determine the Blower Quantity and Size (Digits 4-6) and Motor HP (Digit 20):**
   Using Table 29.1, Model Sizes MDB115, 118 and 120 have blower capability to produce 6000 cfm. The blower performance tables can be found on pages 32-35. Since all can provide the required 6000 cfm, the total static pressure for each blower performance curve must be determined. In this example, the selection process will be shown for 115 only (Digits 4-6 = 115).

   A) The Pressure Drop of an option or accessory is determined by entering the table at the desired cfm and reading across the table until the cfm intersects the desired item. For this example, in Table 34.1 the 2" Permanent Filter has an approximate 0.17"W.C. pressure drop. This would be repeated for the other accessories. As a result, for MDB115:
   - 2" Permanent Filters = 0.17" W.C.
   - Rainhood without Filters = 0.02" W.C.
   - Discharge Damper = 0.07" W.C.
   - Total Internal Static Pressure Drops = 0.26" W.C.

   The Total Static Pressure for the system is determined by Internal Static + External Static = Total Static Pressure.

   For this example 0.26" + 0.74" = 1.00" W.C. T.S.P.

   B) Using the total static pressure (T.S.P.) calculated in step 2A, use blower performance table for the Model Size MDB115 in Table 32.2. Enter the table at the required 6000 cfm and follow the cfm line to the right until it intersects with the T.S.P. line of 1.00" W.C. which is shown at the top of the table. At the point of intersection of these two rows and columns, read the required horsepower. For this example the horsepower is 5. Digit 20 = F.
3. **Determine the Unit Configuration (Digit 7):**
   Looking at the unit configurations shown on page 51, configurations C and D both blow down into the building. The specifier wanted right hand controls. The configurations shown on page 51 are facing the controls. For direct fired, the orientation is determined by looking into the inlet of the unit (air blowing at your back). For configuration C, the controls would be on the right hand side. Digit 7 = C.
4. **Determine the Cabinet Finish/Location (Digit 8):**
   The unit is specified as being outdoor, so the choices are either A (unpainted) or C (painted). Unpainted units are constructed of galvanized steel and can outdoors without paint. Since paint was not specified, Digit 8 = A.
5. **Determine Maximum Input MBH rating (Digits 9-12):**
   The Heating Input capacity was calculated to be 421,810 Btu/hr (422MBH) based on the CFM and indoor and outdoor design temperatures. The maximum input MBH rating is the maximum rating for the burner size and is not representative of the actual firing rate. In this case, a burner rated 550MBH would be required to satisfy 422MBH. Digits 9-12 = 0550.
6. **Determine the Gas Type and Inlet Pressure (Digit 13):**
   For natural gas, 8-14" W.C. inlet pressure, Digit 13 = A.
7. **Determine the Gas Control System (Digit 14):**
   Reviewing the gas control information on pages 13-16, MDB units can use Maxitrol 14, Maxitrol 44 or Maxitrol SC10 gas controls. The customer the unit to be building management control compatible. The Maxitrol SC11 control is required for this compatibility. Digit 14 = D (0-10VDC signal by others).

8. **Determine the Insurance Requirements (Digit 15):** The customer specified FM. Digit 15 = 2 or 3 covers FM less and with restriction respectively. From the information on page 9, if there are inlet blockages such as dampers or filters, FM with restriction must be selected (if FM is required). In the case of this unit, there are filters, so FM with restriction is required. Digit 15=3. Note that if FM was not specified, the standard IRI manifold could have been selected.
9. **Determine Additional Manifold Options (Digit 16):** Since high and low gas switches were not specified, Digit 16 = N.
10. **Determine the Air Control Option (Digit 17):** All 100% make-up air units with single speed motors have Digit 17 = A.
11. **Determine the Supply Voltage (Digit 18):** From item #8 listed above, the 460V/60Hz/3Ph results in Digit 18 = 6.
12. **Determine Bearings/Vibration Isolation (Digit 19):** Since the Bearing Type was not specified and dedicated blower vibration isolation was not specifically called out, the standard spider bearings will be used. Thus, Digit 19 = A. Specify accessory vibration feet for vibration isolation.
13. **Determine the Motor Horsepower (Digit 20):** This was completed in step #2 above. Digit 20 = F.
14. **Determine the Motor Type (Digit 21):** Reviewing Table 37.2, 5HP 460V/60Hz/3ph motors are only available in High Efficiency ODP and TE. Since the motor type was not specified, Hi Eff ODP will be used. Digit 21 = 2.
15. **Determine the Sheave Arrangement (Digit 22):** This digit will be internally assigned by the factory to match the design blower speed.
16. **Determine the Profile Assembly (Digit 23):** This digit will be internally assigned by the factory.

Selection Example - Return Air Unit

Select an outdoor, slab mounted, direct-fired, 75/25 return air unit, space pressure control during occupied and maximum return air with night setback during unoccupied, auto changeover from occupied to unoccupied, FM insurance option, with vibration isolation to meet the following:

1. CFM at sea level = 6,000 cfm
2. Outdoor design temp = 10°F, Return design temp = 60°F (based on night setback temp), Discharge temp = 70°F
3. Heating input capacity = 6000 cfm x (70°F -10°F) x 621 / (460 + 70) = 421,810 Btu/Hr

   Note: Heating capacity is calculated based on 100% outside air mode, not return air mode.
4. External Static Pressure = 0.80"W.C.
5. Right hand controls, airflow is to blow down into building. The following accessories are to be included: 2" Permanent Filters, Rainhood and Inlet Damper
6. Gas Type = Natural gas, 8-14" W.C. supply pressure.
7. Discharge temperature control with room override is required.
8. Supply Voltage: 460V/60Hz/3Ph
9. Altitude: 1000 feet

   With the information listed above, the basic model, using the Model Nomenclature shown on page 51, can be selected as shown in the following example:

1. **Determine the Product Type (Digit 2):**

   The Product Type for return air units is R. Digit 3 represents an internal design sequence and is always B. Digits 1-3 = MRB.
2. Determine the Blower Quantity and Size (Digits 4-6) and Motor HP (Digit 20):

   Using Table 29.1, Model Sizes MRB115, 118 and 120 have blower capability to produce 6000 cfm at 60°F temperature rise and 75/25 RA/OA ratio. The blower performance tables can be found on pages 32-35. Since all can provide the required 6000 cfm, the total static pressure for each blower size must be determined. In this example, the selection process will be shown for 115 only (Digits 4-6 = 115).

   A) The Pressure Drop of an option or accessory is determined by entering the table at the desired cfm and reading across the table until the cfm intersects the desired item. For this example, in Table 32.1 the 2" Permanent Filter has an approximate 0.17"W.C. pressure drop. This would be repeated for the other accessories. As a result, for MRB115:
   - 2" Permanent Filters = 0.17" W.C.
   - Rainhood without Filters = 0.02" W.C.
   - Inlet Damper = 0.01" W.C.
   - Total Internal Static Pressure Drops = 0.20" W.C.

   The Total Static Pressure for the system is determined by Internal Static + External Static = Total Static Pressure. For this example 0.20" + 0.80" = 1.00" W.C. T.S.P.

   B) Same as step 2B in the previous example. Digit 20 = F.
3. Determine the Unit Configuration (Digit 7):

   Same as step 3 in previous example. Digit 7 = C.
4. Determine the Cabinet Finish/Location (Digit 8):

   Same as step 4 in previous example. Digit 8 = A.
5. Determine Maximum Input MBH rating (Digits 9-12):

   Same as step 5 in previous example. Digits 9-12 = 0550.
6. Determine the Gas Type and Inlet Pressure (Digit 13):

   Same as step 6 in previous example. Digit 13 = A.
7. Determine the Gas Control System (Digit 14):

   Reviewing the Gas Control Selection Table 15.1 on page 15, for discharge control, 75/25 units, outdoor air temperatures above -20°F, Maxitrol 14 controls are an acceptable control up to a maximum discharge air temperature of 90°F (the maximum setting on the dial). Note that room override is not available on this control system, so an exception must be noted. Digit 14 = A.
8. Determine the Insurance Requirements (Digit 15):

   Same as step 8 in previous example. Digit 15 = 3.
9. Determine Additional Manifold Options (Digit 16):

   Since high and low gas switches and proof of closure was not specified, Digit 16 = N.
10. Determine the Air Control Option (Digit 17):

    Reviewing the Controls Applications in Table 28.2 on page 28, Control Type C provides the required sequence to meet space pressure control during the occupied period, maximum return air during unoccupied with night setback thermostat and auto changeover between occupied and unoccupied with the timeclock. Digit 17 = H.
11. Determine the Supply Voltage (Digit 18):

    Same as step 11 in previous example. Digit 18 = 6.
12. Determine Bearings/Vibration Isolation (Digit 19):

    Same as step 12 in previous example. Digit 19 = A.
13. Determine the Motor Horsepower (Digit 20):

    This was completed in step #2 above. Digit 20 = F.
14. Determine the Motor Type (Digit 21):

    Same as step 14 in previous example. Digit 21 = 2.
15. Determine the Sheave Arrangement (Digit 22):

    This digit will be internally assigned by the factory to match the design blower speed.
16. Determine the Profile Assembly (Digit 23):

    This digit will be internally assigned by the factory.

STATIC PRESSURE DROP DATA

Table 32.1 - Accessory Static Pressure Drop Data (Inches W.C.)

Model Size	CFM	2" Permanent V-Bank Filters	2" Throwaway V-Bank Filters	2" Farr 30/30 V-Bank Filters	Inlet Dampers	Inlet Hood with Filters	Inlet Hood without Filters	Evap Cooler with Flat Bank Filters	Evap Cooler with Rainhood & Filters	3-Way Louvers	4-Way Louvers	Discharge Damper	Ductless Discharge	CFM
110	2600	0.15	0.18	0.19	0.01	0.06	0.01	0.04	0.08	0.05	0.05	0.05	0.41	2600
	2800	0.18	0.20	0.22	0.01	0.07	0.02	0.05	0.09	0.06	0.05	0.05	0.47	2800
	3000	0.20	0.22	0.25	0.01	0.08	0.02	0.05	0.10	0.07	0.06	0.06	0.54	3000
	3300	0.24	0.26	0.30	0.01	0.09	0.02	0.06	0.11	0.09	0.08	0.08	0.65	3300
112	2000	0.10	0.11	0.12	0.00	0.04	0.01	0.03	0.05	0.03	0.03	0.03	0.12	2000
	2500	0.14	0.17	0.18	0.01	0.06	0.01	0.04	0.07	0.05	0.04	0.04	0.19	2500
	3000	0.20	0.22	0.25	0.01	0.08	0.02	0.05	0.10	0.07	0.06	0.06	0.27	3000
	3500	0.26	0.29	0.33	0.01	0.10	0.02	0.06	0.12	0.10	0.09	0.09	0.37	3500
	4000	0.34	0.37	0.43	0.02	0.12	0.03	0.08	0.15	0.13	0.11	0.11	0.48	4000
	4500	0.42	0.45	0.54	0.02	0.15	0.04	0.10	0.19	0.16	0.14	0.14	0.61	4500
	4700	0.45	0.49	0.59	0.03	0.16	0.05	0.11	0.20	0.17	0.15	0.15	0.66	4700
115	3000	0.05	0.07	0.06	0.00	0.03	0.00	0.03	0.05	0.02	0.02	0.02	0.14	3000
	3500	0.07	0.08	0.08	0.00	0.04	0.01	0.03	0.06	0.03	0.02	0.02	0.19	3500
	4000	0.08	0.10	0.11	0.01	0.05	0.01	0.04	0.07	0.04	0.03	0.03	0.25	4000
	4500	0.10	0.12	0.13	0.01	0.06	0.01	0.05	0.09	0.04	0.04	0.04	0.31	4500
	5000	0.12	0.15	0.16	0.01	0.07	0.01	0.06	0.11	0.06	0.05	0.05	0.39	5000
	5500	0.15	0.17	0.19	0.01	0.08	0.02	0.06	0.12	0.07	0.06	0.06	0.47	5500
	6000	0.17	0.20	0.23	0.01	0.09	0.02	0.07	0.14	0.08	0.07	0.07	0.56	6000
	6500	0.20	0.22	0.26	0.01	0.10	0.02	0.09	0.16	0.09	0.08	0.08	0.65	6500
118	3500	0.07	0.08	0.08	0.00	0.04	0.01	0.03	0.06	0.03	0.02	0.02	0.09	3500
	4000	0.08	0.10	0.11	0.01	0.05	0.01	0.04	0.07	0.04	0.03	0.03	0.12	4000
	5000	0.12	0.15	0.16	0.01	0.07	0.01	0.06	0.11	0.06	0.05	0.05	0.19	5000
	6000	0.17	0.20	0.23	0.01	0.09	0.02	0.07	0.14	0.08	0.07	0.07	0.27	6000
	7000	0.22	0.25	0.30	0.02	0.11	0.03	0.10	0.19	0.11	0.10	0.10	0.37	7000
	8000	0.28	0.32	0.39	0.02	0.14	0.04	0.13	0.24	0.14	0.12	0.12	0.48	8000
	9000	0.35	0.39	0.49	0.03	0.17	0.04	0.16	0.29	0.18	0.16	0.16	0.61	9000
	10000	0.43	0.46	0.60	0.03	0.20	0.06	0.19	0.35	0.22	0.19	0.19	0.76	10000
120	6000	0.05	0.06	0.06	0.00	0.03	0.00	0.04	0.06	0.02	0.02	0.02	0.13	6000
	7000	0.06	0.08	0.08	0.00	0.04	0.01	0.04	0.08	0.03	0.03	0.03	0.17	7000
	8000	0.08	0.09	0.10	0.01	0.05	0.01	0.05	0.10	0.04	0.03	0.03	0.23	8000
	9000	0.09	0.11	0.12	0.01	0.06	0.01	0.06	0.12	0.05	0.04	0.04	0.29	9000
	10000	0.11	0.13	0.15	0.01	0.07	0.01	0.07	0.14	0.06	0.05	0.05	0.35	10000
	11000	0.13	0.15	0.17	0.01	0.08	0.02	0.09	0.17	0.07	0.06	0.06	0.43	11000
	12000	0.15	0.17	0.20	0.01	0.09	0.02	0.10	0.19	0.09	0.08	0.08	0.51	12000
	13000	0.17	0.20	0.24	0.01	0.10	0.02	0.12	0.22	0.10	0.09	0.09	0.60	13000
	13500	0.18	0.21	0.25	0.02	0.11	0.02	0.13	0.24	0.11	0.10	0.10	0.64	13500
122	8000	0.08	0.09	0.10	0.01	0.05	0.01	0.05	0.10	0.04	0.03	0.03	0.15	8000
	9000	0.09	0.11	0.12	0.01	0.06	0.01	0.06	0.12	0.05	0.04	0.04	0.19	9000
	10000	0.11	0.13	0.15	0.01	0.07	0.01	0.07	0.14	0.06	0.05	0.05	0.24	10000
	11000	0.13	0.15	0.17	0.01	0.08	0.02	0.09	0.17	0.07	0.06	0.06	0.29	11000
	12000	0.15	0.17	0.20	0.01	0.09	0.02	0.10	0.19	0.09	0.08	0.08	0.35	12000
	13000	0.17	0.20	0.24	0.01	0.10	0.02	0.12	0.22	0.10	0.09	0.09	0.41	13000
	14000	0.19	0.22	0.27	0.02	0.11	0.02	0.14	0.25	0.12	0.10	0.10	0.47	14000
	15000	0.22	0.25	0.31	0.02	0.13	0.03	0.15	0.29	0.13	0.12	0.12	0.54	15000
	16000	0.25	0.28	0.35	0.02	0.14	0.03	0.17	0.32	0.15	0.13	0.13	0.61	16000
	16500	0.26	0.29	0.37	0.02	0.15	0.03	0.18	0.34	0.16	0.14	0.14	0.65	16500
124	10000	0.11	0.13	0.15	0.01	0.07	0.01	0.07	0.14	0.06	0.05	0.05	0.24	10000
	12000	0.15	0.17	0.20	0.01	0.09	0.02	0.10	0.19	0.09	0.08	0.08	0.35	12000
	14000	0.19	0.22	0.27	0.02	0.11	0.02	0.14	0.25	0.12	0.10	0.10	0.47	14000
	16000	0.25	0.28	0.35	0.02	0.14	0.03	0.17	0.32	0.15	0.13	0.13	0.61	16000
	18000	0.30	0.34	0.44	0.03	0.17	0.04	0.21	0.40	0.19	0.17	0.17	0.78	18000
	20000	0.37	0.40	0.54	0.03	0.20	0.05	0.24	0.49	0.24	0.21	0.21	0.96	20000
	21500	0.42	0.46	0.62	0.04	0.22	0.06	0.26	0.56	0.28	0.24	0.24	1.11	21500

STATIC PRESSURE DROP DATA

Table 33.1 - Accessory Static Pressure Drop Data (Inches W.C.)

Model Size	CFM	2" Permanent V-Bank Filters	2" Throwaway V-Bank Filters	2" Farr 30/30 V-Bank Filters	Inlet Dampers	Inlet Hood with Filters	Inlet Hood without Filters	Evap Cooler with Flat Bank Filters	Evap Cooler with Rainhood & Filters	3-Way Louvers	4-Way Louvers	Discharge Damper	Ductless Discharge	CFM
127	16000	0.12	0.14	0.16	0.01	0.10	0.01	0.07	0.14	0.05	0.04	0.04	0.25	16000
	18000	0.14	0.17	0.20	0.02	0.13	0.02	0.09	0.17	0.06	0.06	0.06	0.31	18000
	20000	0.17	0.20	0.24	0.02	0.15	0.02	0.11	0.21	0.08	0.07	0.07	0.38	20000
	22000	0.20	0.23	0.29	0.03	0.17	0.03	0.13	0.24	0.09	0.08	0.08	0.46	22000
	24000	0.23	0.26	0.34	0.03	n/a	0.03	0.15	0.28	0.11	0.10	0.10	0.55	24000
	26000	0.27	0.30	0.39	0.04	n/a	0.04	0.18	0.33	0.13	0.12	0.12	0.65	26000
130	14000	0.09	0.11	0.12	0.01	0.08	0.01	0.06	0.11	0.04	0.03	0.03	0.14	14000
	16000	0.12	0.14	0.16	0.01	0.10	0.01	0.07	0.14	0.05	0.04	0.04	0.18	16000
	18000	0.14	0.17	0.20	0.02	0.13	0.02	0.09	0.17	0.06	0.06	0.06	0.23	18000
	20000	0.17	0.20	0.24	0.02	0.15	0.02	0.11	0.21	0.08	0.07	0.07	0.29	20000
	22000	0.20	0.23	0.29	0.03	0.17	0.03	0.13	0.24	0.09	0.08	0.08	0.35	22000
	24000	0.23	0.26	0.34	0.03	n/a	0.03	0.15	0.28	0.11	0.10	0.10	0.42	24000
	26000	0.27	0.30	0.39	0.04	n/a	0.04	0.18	0.33	0.13	0.12	0.12	0.49	26000
	28000	0.30	0.34	0.45	0.05	n/a	0.04	0.21	0.37	0.15	0.13	0.13	0.57	28000
	30000	0.34	0.38	0.52	0.05	n/a	0.05	0.24	0.42	0.18	0.15	0.15	0.65	30000
220	18000	0.12	0.15	0.17	0.01	0.08	0.01	0.08	0.15	0.05	0.05	0.05	0.29	18000
	19000	0.13	0.16	0.18	0.01	0.08	0.02	0.09	0.17	0.06	0.05	0.05	0.32	19000
	20000	0.15	0.17	0.20	0.01	0.09	0.02	0.10	0.18	0.06	0.06	0.06	0.35	20000
	21000	0.16	0.19	0.22	0.01	0.10	0.02	0.11	0.20	0.07	0.06	0.06	0.39	21000
	22000	0.17	0.20	0.24	0.01	0.10	0.02	0.11	0.22	0.08	0.07	0.07	0.43	22000
	23000	0.19	0.21	0.26	0.02	0.11	0.02	0.12	0.23	0.08	0.07	0.07	0.47	23000
	24000	0.20	0.23	0.28	0.02	0.11	0.02	0.13	0.25	0.09	0.08	0.08	0.51	24000
	25000	0.21	0.25	0.31	0.02	n/a	0.03	0.15	0.27	0.10	0.09	0.09	0.55	25000
	26000	0.23	0.26	0.33	0.02	n/a	0.03	0.16	0.29	0.11	0.10	0.10	0.60	26000
	27000	0.25	0.28	0.35	0.02	n/a	0.03	0.17	0.31	0.12	0.10	0.10	0.64	27000
222	25000	0.21	0.25	0.31	0.02	n/a	0.03	0.15	0.27	0.10	0.09	0.09	0.37	25000
	26000	0.23	0.26	0.33	0.02	n/a	0.03	0.16	0.29	0.11	0.10	0.10	0.41	26000
	27000	0.25	0.28	0.35	0.02	n/a	0.03	0.17	0.31	0.12	0.10	0.10	0.44	27000
	28000	0.26	0.30	0.38	0.02	n/a	0.03	0.18	0.33	0.13	0.11	0.11	0.47	28000
	29000	0.28	0.31	0.41	0.03	n/a	0.04	0.19	0.35	0.13	0.12	0.12	0.50	29000
	30000	0.30	0.33	0.43	0.03	n/a	0.04	0.21	0.38	0.14	0.13	0.13	0.54	30000
	31000	0.31	0.35	0.46	0.03	n/a	0.04	0.22	0.40	0.15	0.14	0.14	0.58	31000
	32000	0.33	0.37	0.49	0.03	n/a	0.04	0.24	0.42	0.16	0.14	0.14	0.61	32000
	33000	0.35	0.39	0.52	0.03	n/a	0.05	0.25	0.45	0.17	0.15	0.15	0.65	33000
225	30000	0.14	0.17	0.18	0.01	0.09	0.02	0.07	0.14	0.04	0.04	0.04	0.31	30000
	32000	0.16	0.19	0.20	0.01	0.10	0.02	0.08	0.16	0.05	0.04	0.04	0.35	32000
	34000	0.18	0.21	0.23	0.02	0.11	0.02	0.09	0.17	0.06	0.05	0.05	0.40	34000
	36000	0.20	0.23	0.26	0.02	0.12	0.03	0.10	0.19	0.06	0.06	0.06	0.45	36000
	38000	0.22	0.25	0.28	0.02	n/a	0.03	0.11	0.21	0.07	0.06	0.06	0.50	38000
	40000	0.24	0.27	0.31	0.02	n/a	0.03	0.12	0.23	0.08	0.07	0.07	0.55	40000
	42000	0.26	0.29	0.34	0.02	n/a	0.03	0.13	0.25	0.09	0.08	0.08	0.61	42000
	44000	0.29	0.32	0.38	0.03	n/a	0.04	0.14	0.27	0.09	0.08	0.08	0.67	44000
	46000	0.31	0.34	0.41	0.03	n/a	0.04	0.16	0.29	0.10	0.09	0.09	0.73	46000
230	44000	0.29	0.32	0.38	0.03	n/a	0.04	0.14	0.27	0.09	0.08	0.08	0.35	44000
	46000	0.31	0.34	0.41	0.03	n/a	0.04	0.16	0.29	0.10	0.09	0.09	0.38	46000
	48000	0.34	0.37	0.44	0.03	n/a	0.04	0.17	0.31	0.11	0.10	0.10	0.42	48000
	50000	0.36	0.40	0.48	0.03	n/a	0.05	0.18	0.34	0.12	0.11	0.11	0.45	50000
	52000	0.39	0.43	0.52	0.04	n/a	0.05	0.20	0.36	0.13	0.12	0.12	0.49	52000
	54000	0.42	0.46	0.56	0.04	n/a	0.06	0.21	0.39	0.14	0.13	0.13	0.53	54000
	56000	0.45	0.49	0.60	0.04	n/a	0.06	0.23	0.41	0.15	0.14	0.14	0.57	56000
	58000	0.48	0.52	0.64	0.05	n/a	0.07	0.25	0.44	0.16	0.14	0.14	0.61	58000
	60000	0.51	0.55	0.68	0.05	n/a	0.07	0.26	0.47	0.18	0.16	0.16	0.65	60000

BLOWER PERFORMANCE DATA

Table 34.1 - Unit Performance Table ① ②

Model Size	CFM	Total Static Pressure ("W.C.)																			
		0.25		0.5		0.75		1		1.25		1.5		1.75		2		2.5		3	
		BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM
110	1600	0.49	882	0.59	998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1800	0.58	908	0.69	1017	0.82	1119	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2000	0.69	939	0.83	1042	1.02	1139	1.14	1231	-	-	-	-	-	-	-	-	-	-	-	-
	2200	0.86	974	1.04	1071	1.16	1163	1.27	1250	1.38	1334	1.48	1415	-	-	-	-	-	-	-	-
	2400	1.07	1012	1.19	1103	1.30	1190	1.41	1274	1.52	1355	1.66	1432	1.80	1507	1.95	1580	-	-	-	-
	2600	1.22	1052	1.34	1139	1.45	1222	1.57	1302	1.72	1379	1.86	1453	2.01	1526	2.17	1596	-	-	-	-
	2800	1.39	1095	1.49	1177	1.64	1256	1.79	1332	1.93	1406	2.09	1478	2.25	1547	2.42	1615	2.76	1746	-	-
	3000	1.57	1140	1.72	1218	1.87	1293	2.02	1366	2.19	1437	2.36	1505	2.53	1573	2.70	1638	-	-	-	-
	3300	1.95	1210	2.11	1282	2.28	1353	2.45	1421	2.63	1487	2.80	1552	2.98	1615	-	-	-	-	-	-
112	2000	0.56	717	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2500	0.78	751	1.02	843	1.15	927	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3000	1.15	795	1.30	880	1.43	959	1.57	1033	1.74	1103	-	-	-	-	-	-	-	-	-	-
	3500	1.46	846	1.64	925	1.82	998	2.00	1068	2.20	1134	2.40	1197	2.60	1258	2.81	1317	-	-	-	-
	4000	1.92	904	2.13	976	2.34	1044	2.56	1109	2.78	1172	2.99	1232	3.22	1290	3.44	1346	3.89	1452	4.35	1553
	4500	2.51	965	2.74	1032	2.98	1096	3.22	1157	3.46	1216	3.70	1273	3.94	1328	4.18	1381	4.67	1483	-	-
	4700	2.78	991	3.02	1056	3.27	1118	3.52	1177	3.76	1235	4.01	1291	4.26	1345	4.51	1397	4.99	1491	-	-
115	3000	0.78	599	1.06	682	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3500	1.07	618	1.25	696	1.42	768	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4000	1.29	641	1.46	715	1.67	784	1.89	848	2.14	909	-	-	-	-	-	-	-	-	-	-
	4500	1.53	668	1.76	737	1.99	802	2.24	864	2.50	922	2.77	978	3.05	1031	-	-	-	-	-	-
	5000	1.89	697	2.13	763	2.39	825	2.66	883	2.93	939	3.22	993	3.51	1044	3.81	1094	-	-	-	-
	5500	2.32	729	2.59	791	2.86	850	3.14	906	3.43	959	3.73	1011	4.03	1061	4.34	1109	4.97	1200	-	-
	6000	2.83	762	3.11	821	3.40	877	3.70	931	4.00	982	4.31	1032	4.63	1080	4.95	1126	-	-	-	-
	6500	3.41	798	3.71	853	4.02	907	4.33	958	4.65	1007	4.97	1055	-	-	-	-	-	-	-	-
118	3500	0.99	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4000	1.16	519	1.37	591	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5000	1.51	543	1.80	610	2.11	671	2.43	728	2.76	782	-	-	-	-	-	-	-	-	-	-
	6000	2.07	574	2.43	636	2.78	693	3.15	747	3.52	798	3.89	847	4.27	893	4.65	938	-	-	-	-
	7000	2.82	611	3.22	668	3.62	721	4.03	772	4.44	820	4.85	866	5.27	910	5.71	953	6.59	1034	-	-
	8000	3.76	652	4.20	705	4.64	754	5.09	802	5.56	847	6.03	891	6.50	933	6.98	974	7.94	1051	8.93	1124
	9000	4.89	696	5.39	745	5.89	791	6.40	836	6.91	879	7.43	920	7.94	960	8.46	999	9.51	1073	-	-
	10000	6.30	743	6.85	788	7.40	831	7.95	873	8.50	914	9.06	953	9.62	991	-	-	-	-	-	-
120	6000	1.53	447	1.89	503	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7000	1.94	466	2.34	519	2.76	568	3.21	614	-	-	-	-	-	-	-	-	-	-	-	-
	8000	2.48	489	2.90	538	3.35	585	3.82	628	4.30	670	-	-	-	-	-	-	-	-	-	-
	9000	3.14	514	3.59	560	4.06	604	4.55	646	5.06	685	5.60	724	6.16	760	6.74	796	-	-	-	-
	10000	3.93	542	4.41	585	4.90	626	5.43	666	5.97	704	6.54	740	7.13	775	7.72	809	8.97	874	-	-
	11000	4.86	571	5.37	612	5.91	651	6.47	688	7.05	724	7.64	759	8.24	792	8.86	825	10.15	888	11.52	947
	12000	5.97	602	6.53	640	7.10	677	7.68	712	8.28	747	8.90	780	9.52	812	10.18	843	11.53	904	12.94	961
	13000	7.27	634	7.85	670	8.45	705	9.06	738	9.69	771	10.34	803	11.01	834	11.69	864	13.09	922	14.55	977
	13500	7.98	651	8.58	686	9.19	719	9.82	752	10.47	784	11.14	815	11.82	845	12.51	875	13.94	932	-	-
122	8000	2.24	426	2.74	478	3.27	528	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9000	2.75	442	3.28	490	3.83	537	4.41	581	-	-	-	-	-	-	-	-	-	-	-	-
	10000	3.36	460	3.91	506	4.49	549	5.09	590	5.74	630	6.41	669	-	-	-	-	-	-	-	-
	11000	4.06	481	4.65	523	5.26	564	5.91	603	6.59	641	7.28	677	8.00	713	-	-	-	-	-	-
	12000	4.88	503	5.51	542	6.17	580	6.85	617	7.55	653	8.27	688	9.01	722	9.77	756	11.38	820	-	-
	13000	5.84	526	6.51	563	7.20	599	7.91	634	8.64	668	9.39	701	10.16	734	10.96	766	12.62	827	14.35	887
	14000	6.95	551	7.65	585	8.37	619	9.11	652	9.87	685	10.66	716	11.47	747	12.30	778	14.01	837	15.79	894
	15000	8.19	576	8.92	609	9.68	641	10.46	672	11.26	703	12.08	733	12.92	763	13.78	792	15.55	848	17.39	903
	16000	9.58	602	10.36	633	11.16	663	11.98	693	12.81	723	13.66	751	14.54	780	15.43	807	17.26	862	19.15	914
	16500	10.35	615	11.15	645	11.96	675	12.80	704	13.65	733	14.52	761	15.41	789	16.31	816	18.18	869	-	-
124	10000	2.63	362	3.19	407	3.78	451	4.40	493	-	-	-	-	-	-	-	-	-	-	-	-
	12000	3.68	384	4.29	424	4.92	462	5.60	499	6.32	535	7.06	571	-	-	-	-	-	-	-	-
	14000	5.03	413	5.72	447	6.43	481	7.17	514	7.92	547	8.71	579	9.52	610	10.36	640	-	-	-	-
	16000	6.81	444	7.55	475	8.31	505	9.10	535	9.91	565	10.76	594	11.63	622	12.53	650	14.37	705	16.31	758
	18000	8.99	478	9.79	506	10.63	534	11.49	561	12.37	587	13.27	614	14.20	640	15.14	665	17.09	716	19.12	765
	20000	11.67	514	12.55	540	13.45	565	14.37	589	15.31	614	16.27	638	17.26	662	18.26	685	-	-	-	-
	21500	14.03	542	14.95	566	15.91	589	16.88	613	17.86	635	18.87	658	19.89	681	-	-	-	-	-	-

① Total static pressure should include external static pressure and accessory / option static pressure from Tables 32.1 or 33.1.
② Brake Horsepower and RPM values are approximate. Please consult the AccuSpec selection software for accurate values.

BLOWER PERFORMANCE DATA

Table 35.1 - Unit Performance Table ① ②

Model Size	CFM	Total Static Pressure ("W.C.)																			
		0.25		0.5		0.75		1		1.25		1.5		1.75		2		2.5		3	
		BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM
125	10000	2.45	356	3.08	404	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12000	3.30	373	3.97	416	4.67	457	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14000	4.40	395	5.11	434	5.88	471	6.70	507	7.55	541	8.43	575	-	-	-	-	-	-	-	-
	16000	5.80	420	6.59	455	7.41	489	8.27	522	9.16	554	10.08	585	11.06	615	12.06	645	-	-	-	-
	18000	7.55	448	8.40	480	9.27	511	10.18	541	11.13	571	12.11	600	13.13	628	14.17	656	16.36	709	-	-
	20000	9.67	478	10.58	507	11.53	536	12.50	564	13.50	591	14.53	618	15.60	645	16.69	670	18.96	721	-	-
	21500	11.55	501	12.51	529	13.49	556	14.51	582	15.56	608	16.63	634	17.73	659	18.86	684	-	-	-	-
127	12000	2.69	315	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14000	3.48	327	4.17	366	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16000	4.45	341	5.19	378	5.99	412	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	18000	5.65	358	6.47	392	7.32	424	8.20	455	9.11	485	-	-	-	-	-	-	-	-	-	-
	20000	7.12	377	7.99	408	8.89	438	9.82	467	10.79	495	11.80	522	12.83	548	-	-	-	-	-	-
	22000	8.84	397	9.77	426	10.74	454	11.74	481	12.77	508	13.82	533	14.90	558	16.01	583	-	-	-	-
	24000	10.87	418	11.87	445	12.90	472	13.96	497	15.04	522	16.15	546	17.28	570	18.44	593	-	-	-	-
	26000	13.23	441	14.30	466	15.39	491	16.51	515	17.65	538	18.81	561	20.00	584	-	-	-	-	-	-
130	14000	3.23	292	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	16000	3.98	300	4.85	338	5.82	374	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	18000	4.88	310	5.81	345	6.83	379	7.90	412	-	-	-	-	-	-	-	-	-	-	-	-
	20000	5.99	323	6.98	355	8.02	387	9.12	417	10.29	446	11.52	475	-	-	-	-	-	-	-	-
	22000	7.30	337	8.33	367	9.42	396	10.57	425	11.78	452	13.05	479	14.37	505	-	-	-	-	-	-
	24000	8.83	352	9.91	380	11.06	407	12.26	434	13.51	460	14.82	486	16.17	511	17.57	535	-	-	-	-
	26000	10.60	368	11.75	394	12.95	420	14.20	445	15.50	470	16.84	561	18.23	518	19.67	541	22.69	586	-	-
	28000	12.65	384	13.85	409	15.10	434	16.40	457	17.75	481	19.13	504	20.57	526	22.05	548	-	-	-	-
	30000	14.96	402	16.23	425	17.54	448	18.88	471	20.28	493	21.72	515	23.20	536	24.72	557	-	-	-	-
220	18000	6.18	516	7.08	562	8.02	606	8.98	648	9.98	688	11.03	726	12.10	763	-	-	-	-	-	-
	19000	6.94	530	7.87	574	8.84	617	9.83	657	10.87	696	11.95	734	13.05	770	14.18	805	-	-	-	-
	20000	7.76	545	8.73	587	9.72	628	10.76	668	11.84	706	12.94	742	14.07	778	15.22	812	-	-	-	-
	21000	8.66	559	9.66	601	10.70	640	11.77	679	12.87	716	14.00	751	15.16	786	16.35	820	18.80	884	-	-
	22000	9.63	575	10.67	615	11.75	653	12.85	690	13.99	726	15.15	761	16.34	795	17.55	828	-	-	-	-
	23000	10.69	590	11.77	629	12.88	666	14.02	702	15.18	737	16.38	771	17.60	804	18.84	836	-	-	-	-
	24000	11.84	606	12.96	644	14.10	680	15.27	715	16.47	749	17.69	782	18.94	814	-	-	-	-	-	-
	25000	13.08	622	14.23	659	15.40	694	16.61	728	17.84	761	19.09	794	-	-	-	-	-	-	-	-
	26000	14.41	639	15.59	674	16.80	708	18.04	742	19.30	774	-	-	-	-	-	-	-	-	-	-
	27000	15.83	656	17.05	690	18.29	723	19.56	755	-	-	-	-	-	-	-	-	-	-	-	-
222	25000	10.64	518	11.92	556	13.25	593	14.64	628	16.07	663	17.56	697	19.08	729	20.66	761	23.95	823	-	-
	26000	11.64	530	12.95	567	14.32	602	15.74	637	17.20	671	18.71	704	20.27	736	21.87	767	25.20	828	26.93	857
	27000	12.71	542	14.06	578	15.46	613	16.90	646	18.40	679	19.93	711	21.53	743	23.15	773	26.53	833	28.29	861
	28000	13.85	555	15.23	589	16.66	623	18.14	656	19.66	688	21.24	719	22.86	750	24.51	780	27.94	838	29.72	866
	29000	15.06	567	16.48	601	17.95	634	19.45	666	21.02	697	22.62	728	24.26	758	25.94	787	29.43	844	-	-
	30000	16.35	580	17.81	613	19.30	645	20.86	676	22.44	707	24.08	737	25.74	766	27.46	795	-	-	-	-
	31000	17.72	593	19.21	625	20.75	656	22.33	687	23.95	717	25.61	746	27.31	774	29.05	803	-	-	-	-
	32000	19.17	606	20.71	637	22.28	668	23.89	698	25.53	727	27.23	755	28.97	783	-	-	-	-	-	-
	33000	20.72	620	22.28	650	23.88	680	25.52	709	27.21	737	28.94	765	-	-	-	-	-	-	-	-
225	30000	10.05	411	11.57	448	13.17	483	14.84	516	16.59	547	18.42	577	20.32	606	-	-	-	-	-	-
	32000	11.54	424	13.12	460	14.77	493	16.50	525	18.29	556	20.17	585	22.11	613	24.12	641	-	-	-	-
	34000	13.20	438	14.83	472	16.55	504	18.32	535	20.18	565	22.10	594	24.08	621	26.13	648	-	-	-	-
	36000	15.04	452	16.74	485	18.50	516	20.34	546	22.24	575	24.21	603	26.24	630	28.34	656	32.73	706	-	-
	38000	17.07	466	18.82	498	20.65	528	22.55	557	24.50	586	26.52	613	28.60	639	30.74	664	35.24	713	37.58	737
	40000	19.29	481	21.12	512	23.00	541	24.95	569	26.96	597	29.04	623	31.17	649	33.38	673	37.97	721	-	-
	42000	21.73	497	23.61	526	25.56	554	27.57	582	29.64	608	31.78	634	33.98	659	36.24	683	-	-	-	-
	44000	24.37	512	26.32	541	28.34	568	30.40	595	32.55	620	34.75	645	37.01	670	39.32	693	-	-	-	-
	46000	27.25	528	29.27	555	31.35	582	33.50	608	35.70	633	37.96	657	-	-	-	-	-	-	-	-
230	36000	9.71	312	11.56	347	13.50	381	15.53	414	-	-	-	-	-	-	-	-	-	-	-	-
	38000	10.78	318	12.68	352	14.67	385	16.76	416	-	-	-	-	-	-	-	-	-	-	-	-
	40000	11.94	325	13.90	357	15.95	389	18.09	419	20.32	449	-	-	-	-	-	-	-	-	-	-
	42000	13.20	332	15.22	363	17.33	393	19.52	423	21.81	451	24.17	479	-	-	-	-	-	-	-	-
	44000	14.56	339	16.64	369	18.81	398	21.07	427	23.40	455	25.81	482	28.30	508	-	-	-	-	-	-
	46000	16.03	346	18.17	375	20.40	404	22.72	431	25.10	458	27.57	485	30.11	510	-	-	-	-	-	-
	48000	17.62	354	19.82	382	22.12	410	24.48	436	26.92	462	29.50	488	32.05	513	34.74	538	-	-	-	-
	50000	19.32	362	21.59	389	23.94	416	26.37	442	28.87	467	31.45	492	34.12	516	36.86	540	-	-	-	-
	52000	21.15	370	23.48	397	25.89	422	28.38	448	30.94	472	33.60	496	36.32	520	39.11	543	44.87	589	-	-
	54000	23.11	379	25.49	404	27.97	429	30.52	454	33.16	478	35.87	501	38.65	524	41.48	547	47.36	591	-	-
	56000	25.18	387	27.65	412	30.18	436	32.81	460	35.51	483	38.28	506	41.11	529	44.00	551	49.98	594	-	-
	58000	27.41	396	29.94	420	32.55	444	35.24	467	38.00	489	40.82	512	43.71	534	46.66	555	-	-	-	-
	60000	29.77	405	32.38	428	35.06	451	37.82	474	40.63	496	43.51	518	46.46	539	49.46	560	-	-	-	-

① Total static pressure should include external static pressure and accessory / option static pressure from Tables 32.1 or 33.1.
② Brake Horsepower and RPM values are approximate. Please consult the AccuSpec selection software for accurate values.

BLOWER SHEAVE ASSEMBLY DATA

Table 36.1 - Sheave Turns Open Data

Digit 4-6 Unit Size	Digit 19 Bearing Type	Digit 20 Motor HP	Digit 22 Sheave Arrangement	Adjustable Motor Sheave Turns Open Setting												
				0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
110	All	A	A	1117	1080	1043	1005	968	931	894	857	819	782	745		
		A	B	1346	1301	1256	1211	1166	1122	1077	1032	987	942	897		
		B	C	1105	1074	1044	1013	982	952	921	890	859	829	798		
		B	D	1286	1250	1215	1179	1143	1108	1072	1036	1000	965	929		
		C	E	1432	1392	1352	1313	1273	1233	1193	1153	1114	1074	1034		
		C	F	1583	1541	1500	1458	1417	1375	1333	1292	1250	1209	1167		
		C	G	1212	1178	1145	1111	1077	1044	1010	976	942	909	875		
		D	H	1432	1392	1352	1313	1273	1233	1193	1153	1114	1074	1034		
		D	I	1500	1458	1417	1375	1333	1292	1250	1208	1166	1125	1083		
		D	J	1703	1656	1608	1561	1514	1467	1419	1372	1325	1277	1230		
		E	K	1412	1381	1351	1320	1289	1259	1228	1197	1166	1136	1105		
		E	L	1667	1625	1584	1542	1500	1459	1417	1375	1333	1292	1250		
		E	M	1917	1875	1834	1792	1750	1709	1667	1625	1583	1542	1500		
112	All	A	A	921	890	860	829	798	768	737	706	675	645	614		
		B	B	1010	976	943	909	875	842	808	774	740	707	673		
		C	C	1212	1178	1145	1111	1077	1044	1010	976	942	909	875		
		C	D	1016	988	960	931	903	875	847	819	790	762	734		
		C	E	847	819	791	762	734	706	678	650	621	593	565		
		D	F	1340	1303	1266	1228	1191	1154	1117	1080	1042	1005	968		
		D	G	1105	1074	1044	1013	982	952	921	890	859	829	798		
		D	H	913	888	862	837	811	786	761	735	710	684	659		
		E	I			1564	1527	1489	1452	1415	1378	1340	1303	1266	1228	1191
		E	J	1346	1312	1279	1245	1212	1178	1144	1111	1077	1044	1010		
		E	K	1129	1101	1073	1044	1016	988	960	932	903	875	847		
		F	L			1714	1678	1643	1607	1571	1536	1500	1464	1428	1393	1357
		F	M			1474	1443	1413	1382	1351	1321	1290	1259	1228	1198	1167
		F	N			1312	1285	1257	1230	1203	1176	1148	1121	1094	1066	1039
115	All	B	A	724	704	684	664	644	624	603	583	563	543	523		
		C	B	875	851	826	802	778	754	729	705	681	656	632		
		C	C	724	704	684	664	644	624	603	583	563	543	523		
		D	D	972	940	907	875	842	810	778	745	713	680	648		
		D	E	768	747	725	704	683	662	640	619	598	576	555		
		E	F	1129	1101	1073	1044	1016	988	960	932	903	875	847		
		E	G			955	932	909	887	864	841	818	795	773	750	727
		E	H	805	785	765	744	724	704	684	664	643	623	603		
		F	I			1312	1285	1257	1230	1203	1176	1148	1121	1094	1066	1039
		F	J			1135	1111	1088	1064	1041	1017	993	970	946	923	899
		F	K			966	946	926	905	885	865	845	825	804	784	764
		F	L			845	825	805	785	765	745	724	704	684	664	644
118	A	B	A	571	552	533	514	495	476	456	437	418	399	380		
		C	B	682	659	637	614	591	569	546	523	500	478	455		
		D	C	768	747	725	704	683	662	640	619	598	576	555		
		D	D	618	601	584	566	549	532	515	498	480	463	446		
		E	E	854	833	811	790	768	747	726	704	683	661	640		
		E	F	722	704	686	668	650	632	613	595	577	559	541		
		E	G	610	597	583	570	557	544	530	517	504	490	477		
		F	H			1024	1003	981	960	939	918	896	875	854	832	811
		F	I			883	867	850	834	818	802	785	769	753	736	720
		F	J			799	780	761	742	723	704	685	666	647	628	609
		F	K			661	647	634	620	606	593	579	565	551	538	524
		G	L			1141	1122	1103	1084	1065	1046	1027	1008	989	970	951
		G	M			1029	1012	995	978	961	944	926	909	892	875	858
		G	N	922	906	891	875	859	844	828	812	797	781	765	750	734
		G	P	813	799	786	772	758	744	731	717	703	689	676	662	648
		H	Q	1201	1184	1167	1150	1132	1115	1098	1081	1064	1047	1029	1012	995
		H	R	1047	1032	1017	1002	987	972	958	943	928	913	898	883	868
	B,C	B	A	571	552	533	514	495	476	456	437	418	399	380		
		C	B	673	651	628	606	583	561	539	516	494	471	449		
		D	C	750	729	708	688	667	646	625	604	584	563	542		
		D	D	625	604	583	563	542	521	500	479	459	438	417		
		E	E	833	812	791	771	750	729	708	687	667	646	625		
		E	F			680	667	655	642	630	617	604	592	579	567	554
		E	G			604	591	579	566	554	541	528	516	503	491	478
		F	H			1016	997	978	960	941	922	903	884	866	847	828
		F	I			903	884	865	847	828	809	790	771	753	734	715
		F	J	792	771	750	729	708	688	667	646	625	604	583		
		G	K	1146	1131	1115	1100	1084	1069	1053	1038	1022	1007	991	976	960
		G	L	1022	1009	996	983	970	957	945	932	919	906	893	880	867
		G	M	914	899	883	868	852	837	821	806	790	775	759	744	728
		G	N	813	799	786	772	758	744	731	717	703	689	676	662	648
		H	P	1208	1191	1173	1156	1139	1121	1104	1087	1069	1052	1035	1017	1000
		H	Q	1064	1046	1028	1010	992	974	956	938	920	902	884	866	848

Digit 4-6 Unit Size	Digit 19 Bearing Type	Digit 20 Motor HP	Digit 22 Sheave Arrangement	Adjustable Motor Sheave Turns Open Setting												
				0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
120	All	D	A	571	552	533	514	495	476	456	437	418	399	380		
		E	B	654	638	621	605	589	573	556	540	524	507	491		
		E	C	530	517	504	490	477	464	451	438	424	411	398		
		F	D			758	740	722	704	686	668	649	631	613	595	577
		F	E			628	613	598	583	568	554	539	524	509	494	479
		F	F	500	490	481	471	462	452	442	433	423	414	404		
		G	G			843	830	817	805	792	779	766	753	741	728	715
		G	H	754	741	728	716	703	690	677	664	651	639	626	613	600
		G	I	658	647	636	625	613	602	591	580	569	558	546	535	524
		H	J	945	932	920	907	894	881	869	856	843	830	818	805	792
		H	K	825	814	803	792	780	769	758	747	736	725	713	702	691
		H	L	752	741	731	720	709	698	688	677	666	655	645	634	623
122	All	E	A	530	517	504	490	477	464	451	438	424	411	398		
		E	B	438	426	415	403	392	380	368	357	345	334	322		
		F	C			628	613	598	583	568	554	539	524	509	494	479
		F	D			500	488	476	464	452	441	429	417	405	393	381
		G	E	754	741	728	716	703	690	677	664	651	639	626	613	600
		G	F	658	647	636	625	613	602	591	580	569	558	546	535	524
		G	G	552	543	533	524	515	505	496	487	477	468	459	449	440
		H	H	825	814	803	792	780	769	758	747	736	725	713	702	691
		H	I	752	741	731	720	709	698	688	677	666	655	645	634	623
		H	J	665	655	645	634	624	614	604	593	583	573	563	552	542
124	Refer to Breeze AccuSpec															
125	All	E	A	438	426	415	403	392	380	368	357	345	334	322		
		E	B	355	346	337	328	319	311	302	293	284	275	266		
		F	C			515	504	494	483	472	462	451	440	429	419	408
		F	D			468	457	446	435	424	413	401	390	379	368	357
		F	E			414	405	397	388	380	371	362	354	345	337	328
		G	F	599	590	580	571	562	552	543	534	524	515	506	496	487
		G	G			517	508	500	491	483	474	465	457	448	440	431
		G	H			457	450	443	436	429	422	415	408	401	394	387
		H	I	658	647	636	625	613	602	591	580	569	558	546	535	524
		H	J			561	552	542	533	524	515	505	496	487	477	468
		H	K	509	500	492	483	474	466	457	448	440	431	422	414	405
127	All	E	A	355	346	337	328	319	311	302	293	284	275	266		
		F	B	421	410	399	388	377	366	354	343	332	321	310		
		F	C			345	336	328	319	311	302	293	285	276	268	259
		G	D	473	466	458	451	443	436	429	421	414	406	399	391	384
		G	E			415	408	401	394	387	381	374	367	360	353	346
		H	F	546	539	531	524	517	509	502	495	487	480	473	465	458
		H	G	480	473	465	458	450	443	436	428	421	413	406	398	391
		H	H	411	405	399	393	387	381	376	370	364	358	352	346	340
130	All	F	A			393	384	374	365	355	346	337	327	318	308	299
		F	B			332	325	318	311	304	298	291	284	277	270	263
		F	C			299	293	287	280	274	268	262	256	249	243	237
		G	D			415	408	401	394	387	381	374	367	360	353	346
		G	E	370	364	358	353	347	341	335	329	323	318	312	306	300
		H	F	461	455	449	442	436	430	424	417	411	405	399	392	386
		H	G	411	405	399	393	387	381	376	370	364	358	352	346	340
		H	H			374	368	361	355	349	343	336	330	324	317	311
220	All	G	A	633	622	612	601	590	580	569	558	548	537	526	516	505
		H	B	705	692	679	666	653	640	627	614	601	588	575		
		H	C	622	611	599	588	576	565	553	542	530	519	507		

ELECTRICAL DATA

Total Unit Amp Draw

The total unit amp draw is a combination of the motor and the control circuit amp draws and can be calculated with the tables shown below.

Unit Control Circuit Amp Draw (Table 37.1) =

Motor Amp Draw (Tables 37.2 - 37.3) = _____

Total Unit Amp Draw: =

Table 37.1 - Unit Control Circuit Amp Draw

Unit Supply Voltage			
115	**208**	**230**	**460**
3.8	2.4	2.2	1.1

Table 37.2 - Motor Data - 1-Phase (60Hz) ① ②

			115V	208V	230V	
HP	**Motor Type**	**Frame Size**	**Amp Draw**	**Amp Draw**	**Amp Draw**	**Efficiency %**
3/4	ODP	56	11.0	5.5	5.4	③
	TE	56	11.0	5.5	5.4	
1	ODP	56	13.6	6.8	6.6	
	TE	56	12.0	6.2	6.0	
1-1/2	ODP	56	15.0	7.8	7.5	
	TE	56	15.0	7.8	7.5	
2	ODP	145T	20.4	10.2	10.0	
	TE	182T	20.0	10.8	10.0	
3	ODP	184T	34.0	17.4	17.0	
	TE	184T	32.0	14.8	16.0	
5	ODP	184T	-	23.5	21.0	
	TE	184T	-	21.5	19.5	
7-1/2	ODP	215T	-	37.2	35.5	
	TE	215T	-	35.0	30.0	

① Single phase motors, 1-1/2 HP and smaller, feature integral thermal overload protection. Motors 2 HP and larger require external protection. The optional motor starter or variable frequency drive for those sizes provides overcurrent protection.

② Single phase motors are not suitable for use with variable frequency drives.

③ Motors manufacturers do not rate single-phase motors for efficiency.

Table 37.3 - Motor Data - 3-Phase (60Hz) ① ②

			208V		230V		460V		575V	
HP	**Motor Type**	**Frame Size**	**Amp Draw**	**Efficiency %**	**Amp Draw**	**Efficiency %**	**Amp Draw**	**Efficiency %**	**Amp Draw**	**Efficiency %**
3/4	ODP	56	2.8	75.5	3.2	75.5	1.6	75.5	1.1	75.5
	TE	56	3.0	78.9	3.0	78.9	1.5	78.9	1.3	73.4
1	ODP	143T	3.6	82.5	3.4	85.5	1.7	85.5	1.3	85.5
	TE	143T	3.9	85.5	3.2	85.5	1.6	85.5	1.1	85.5
1-1/2	ODP	145T	5.3	84.0	5.6	86.5	2.8	86.5	1.8	86.5
	TE	145T	5.5	86.5	4.8	86.5	2.4	86.5	1.9	86.5
2	ODP	145T	6.7	84.0	5.8	86.5	2.9	86.5	2.4	86.5
	TE	145T	6.7	86.5	5.7	86.5	2.8	86.5	2.3	86.5
3	ODP	182T	9.0	89.5	8.6	89.5	4.3	89.5	3.4	89.5
	TE	182T	9.1	87.5	8.4	89.5	4.2	89.5	3.2	89.5
5	ODP	184T	15.7	87.5	13.6	89.5	6.8	89.5	5.4	89.5
	TE	184T	14.7	89.5	12.8	89.5	6.4	89.5	5.1	89.5
7-1/2	ODP	213T	22.3	91.0	19.8	91.0	9.9	91.0	7.5	91.0
	TE	213T	20.9	91.7	21.6	91.7	10.8	91.7	8.6	91.7
10	ODP	215T	29.0	91.7	25.6	91.7	12.8	91.7	10.0	91.7
	TE	215T	28.3	89.5	26.8	91.7	13.4	91.7	10.7	91.7
15	ODP	254T	43.4	93.0	37.8	93.0	18.9	93.0	15.1	93.0
	TE	254T	42.0	92.4	38.1	92.4	19.1	92.4	15.8	92.4
20	ODP	256T	57.0	93.0	51.0	93.0	25.5	93.0	19.6	93.0
	TE	256T	56.6	91.0	49.0	93.0	24.5	93.0	20.4	93.0
25	ODP	284T	70.0	93.6	61.0	93.6	30.5	93.6	23.8	93.6
	TE	284T	69.0	93.6	62.0	93.6	31.0	93.6	24.8	93.6
30	ODP	286T	82.2	94.1	73.2	94.1	36.6	94.1	28.6	94.1
	TE	286T	81.0	93.6	73.0	93.6	36.5	93.6	29.7	93.6
40	ODP	324T	113.0	93.0	97.0	94.1	48.5	94.1	38	94.1
	TE	324T	106.0	94.1	94.8	94.1	47.4	94.1	37.8	94.1
50	ODP	326T	139.2	94.5	121.0	94.5	60.5	94.5	48	94.5
	TE	326T	131.0	93.0	120.0	94.5	60.0	94.5	47.9	94.5

① All 3 phase motors require overload protection. The optional motor starter or variable frequency drive provides overcurrent protection.

② All motors rated 1 HP and greater are suitable for use with variable frequency drives.

UNIT AND ACCESSORY DIMENSIONS

MDB/MRB 110-118 Dimensions

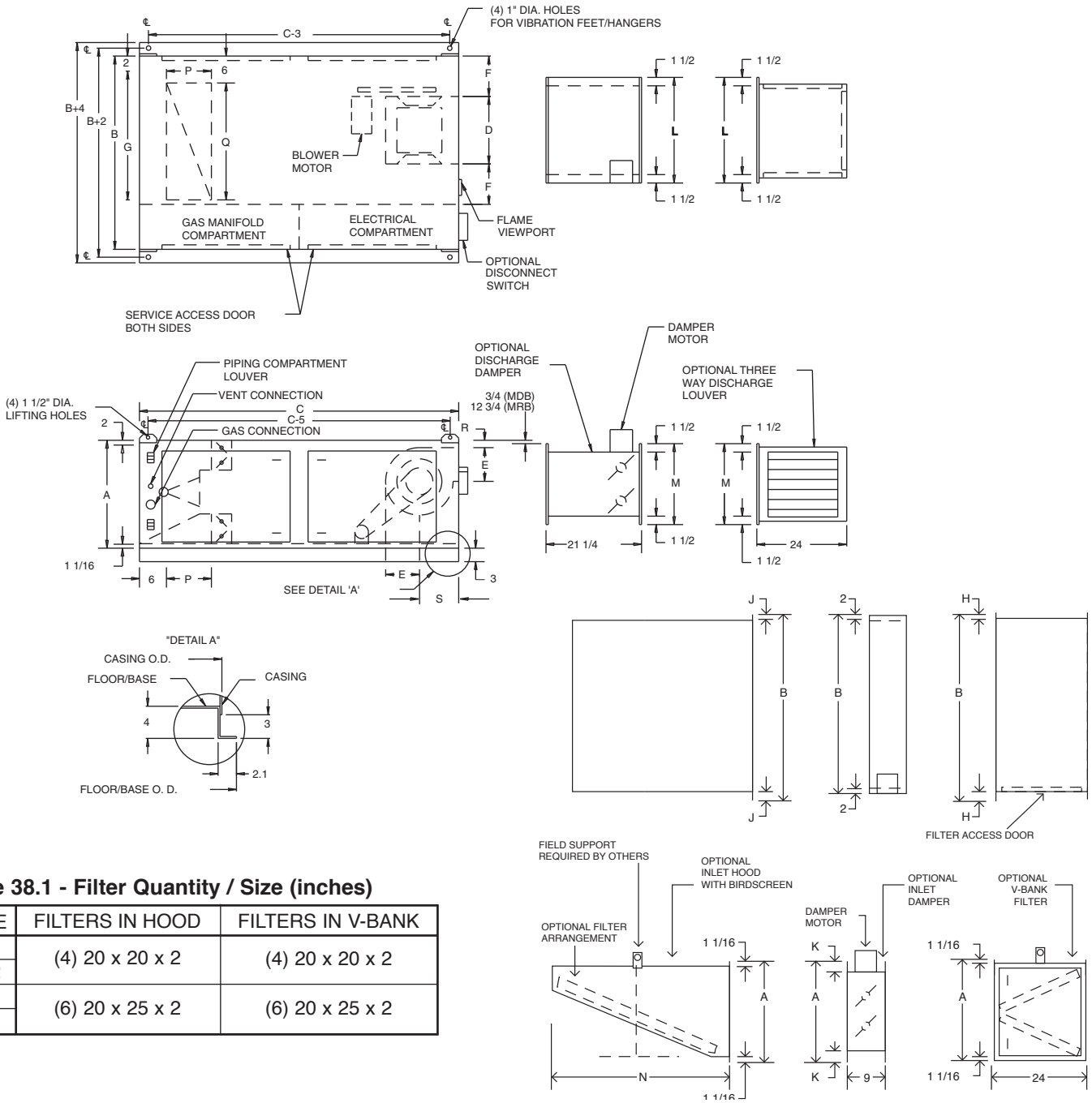


Table 38.1 - Filter Quantity / Size (inches)

SIZE	FILTERS IN HOOD	FILTERS IN V-BANK
110	(4) 20 x 20 x 2	(4) 20 x 20 x 2
112		
115	(6) 20 x 25 x 2	(6) 20 x 25 x 2
118		

Table 38.2 - MDB / MRB Unit Dimensions (All dimensions in inches)

SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S
110	24/36 ①	43	71	13 1/4	11 1/2	9 7/8	30	1 1/8	1 1/2	3/4/ 1 1/4 ③	21	20	38 1/2	10	26	2 1/4 ②	6 1/4
112	24/36 ①	43	71	15 3/4	13 9/16	8 5/8	30	1 1/8	1 1/2	3/4/ 1 1/4 ③	21	20	38 1/2	10	26	14 1/4 ②	7 3/16
115	36	52	82	18 3/4	16	11 5/8	39	7/8	1	1 1/4	26 1/2	25 1/2	54 3/8	12	35	2 1/4	8 5/8
118	36	52	82	22	19	10	39	7/8	1	1 1/4	26 1/2	25 1/2	54 3/8	12	35	2 1/4	10 9/16

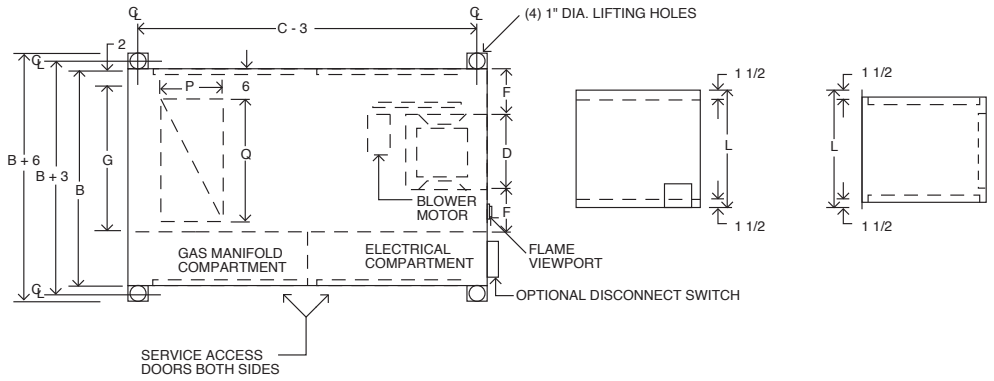
Note: All accessories shipped completely assembled for easy installation. Some accessories shipped separately. All data subject to change.
All dimensions subject to manufacturing tolerances.

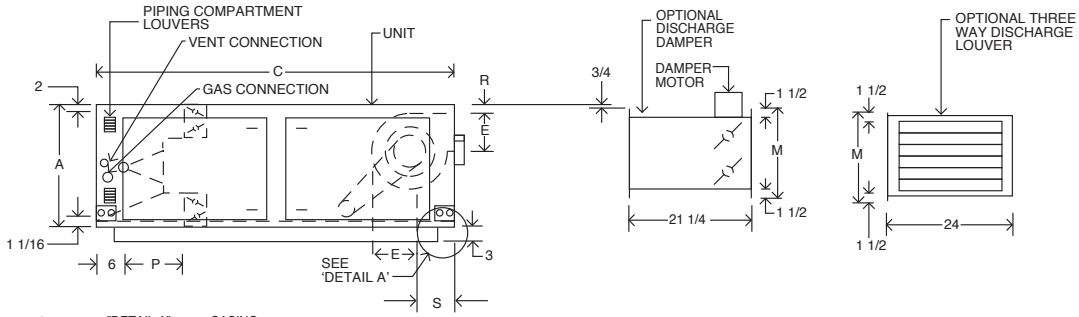
MATERIAL GAUGES: Unit Casing: 18 gauge galvanized. • Unit Base: (110-118) 12 gauge galvanized.
Rain Hood: 18 gauge galvanized. • V-Bank: 14 and 18 gauge galvanized. • Damper Blades: 18 gauge galvanized.
Damper Frame: 14 gauge galvanized. • Discharge Louvers: 14 and 18 gauge galvanized.

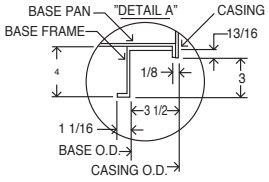
① 24" for MDB models, 36" for MRB models.
② 2-1/4" for MDB models, 14-1/4" for MRB models.
③ 3/4" for MDB models, 1-1/4" for MRB models.

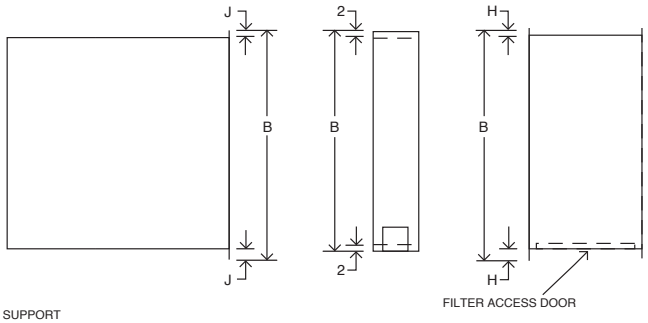
UNIT AND ACCESSORY DIMENSIONS

MDB/MRB 120-130 Dimensions









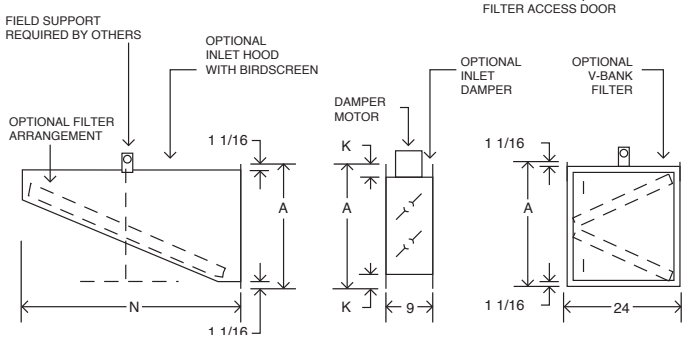


Table 39.1 - Filter Quantity / Size (inches)

Model Size	Filter Location	
	Inlet Hood	V-Bank Section
120	(9) 20 x 25 x 2	(12) 20 x 25 x 2
122		
124		
125	(6) 20 x 25 x 2 (9) 16 x 25 x 2	(10) 20 x 20 x 2 (10) 20 x 25 x 2
127		
130		

Table 39.2 - MDB / MRB Unit Dimensions (All dimensions in inches)

Model Size	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S
120	48	78	96	24 7/8	24 7/8	18 9/16	59	1 5/16	1 1/2	1 3/4	31 1/2	31	45 3/8	14	55	2 1/4	11 1/4
122	48	78	96	27 3/8	27 3/8	17 5/16	59	1 5/16	1 1/2	1 3/4	31 1/2	31	45 3/8	14	55	2 1/4	12 1/4
124	48	78	96	28 3/8	31 3/8	16 13/16	59	1 5/16	1 1/2	1 3/4	31 1/2	31	45 3/8	14	55	2 1/4	13 1/4
125	60	92	110	31 3/8	31 3/8	22 5/16	73	1 1/16	1	2 1/4	41 1/2	42	56	20	69	2 1/4	13 1/4
127	60	92	110	34 3/8	34 3/8	20 13/16	73	1 1/16	1	2 1/4	41 1/2	42	56	20	69	2 1/4	15 1/4
130	60	92	110	36 7/8	36 7/8	19 9/16	73	1 1/16	1	2 1/4	41 1/2	42	56	20	69	2 1/4	16 1/4

Note: All accessories shipped completely assembled for easy installation. Some accessories shipped separately. All data subject to change.
All dimensions subject to manufacturing tolerances.

MATERIAL GAUGES: Unit Casing: 18 gauge galvanized. • Unit Channel Base: (120-130) 12 gauge galvanized.
Rain Hood: 18 gauge galvanized. • V-Bank: 14 and 18 gauge galvanized. • Damper Blades: 18 gauge galvanized.
Damper Frame: 14 gauge galvanized. • Discharge Louvers: 14 and 18 gauge galvanized.

UNIT AND ACCESSORY DIMENSIONS

MDB/MRB 220-230 Dimensions

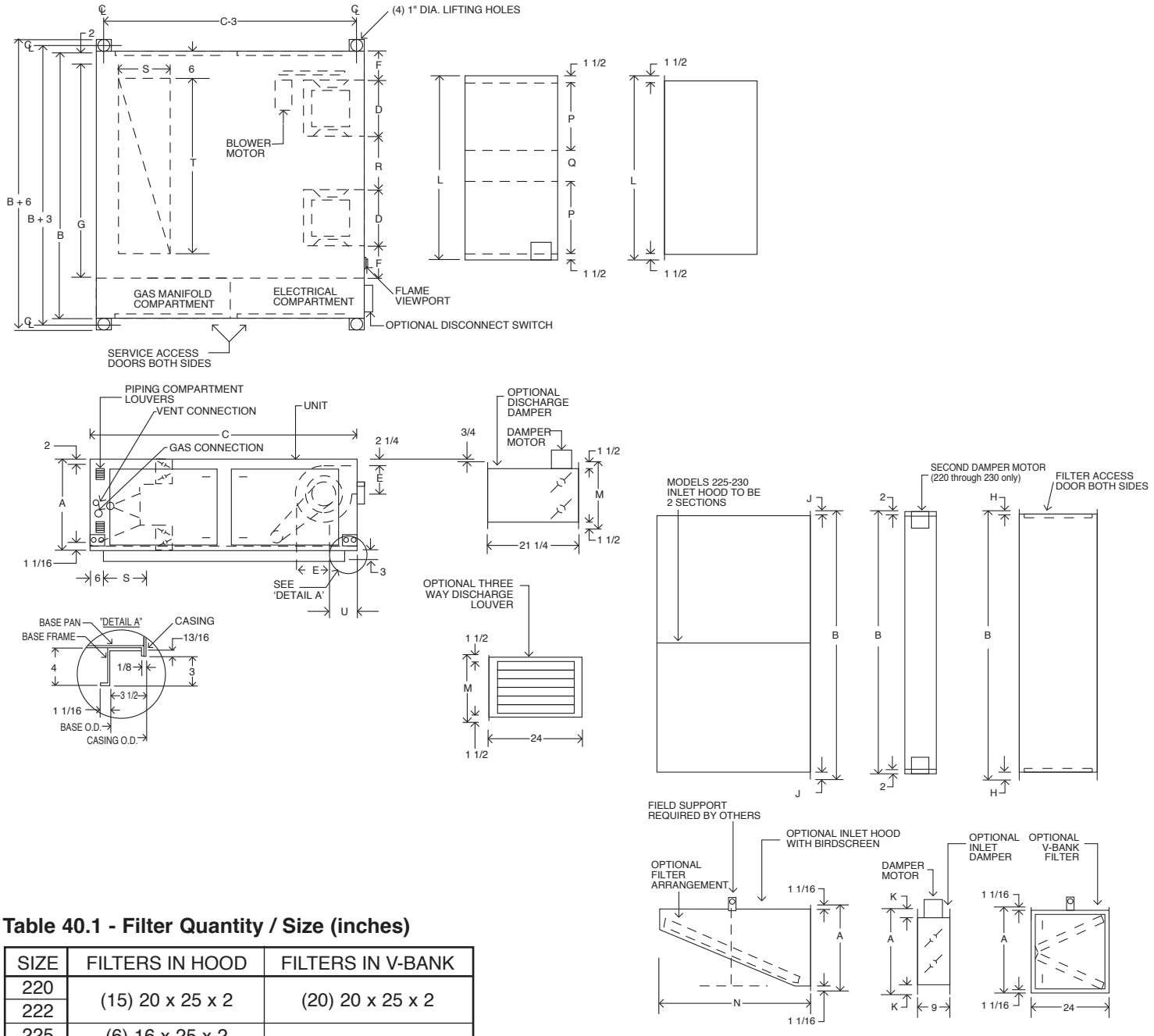


Table 40.1 - Filter Quantity / Size (inches)

SIZE	FILTERS IN HOOD	FILTERS IN V-BANK
220	(15) 20 x 25 x 2	(20) 20 x 25 x 2
222		
225	(6) 16 x 25 x 2 (18) 20 x 25 x 2	(36) 20 x 25 x 2
230		

Table 40.2 - MDB / MRB Unit Dimensions (All dimensions in inches)

SIZE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U
220	48	130	96	24 7/8	24 7/8	16 1/16	111	2 11/16	2 1/2	1 3/4	88	31	45 3/8	28 1/2	28	32 1/8	14	107	11 1/4
222	48	130	96	27 3/8	27 3/8	14 13/16	111	2 11/16	2 1/2	1 3/4	88	31	45 3/8	28 1/2	28	29 5/8	14	107	12 1/4
225	60	154	110	31 3/8	31 3/8	18 13/16	135	2 3/8	2	2 1/4	110	42	56	38 1/2	30	37 5/8	20	131	13 1/2
230	60	154	110	36 7/8	36 7/8	16 1/16	135	2 3/8	2	2 1/4	110	42	56	38 1/2	30	32 1/8	20	131	16 3/4

Note: All accessories shipped completely assembled for easy installation. Some accessories shipped separately. All data subject to change.
All dimensions subject to manufacturing tolerances.

MATERIAL GAUGES: Unit Casing: 18 gauge galvanized. • Unit Channel Base: (220-230) 12 gauge galvanized.
Rain Hood: 18 gauge galvanized. • V-Bank: 14 and 18 gauge galvanized. • Damper Blades: 18 gauge galvanized.
Damper Frame: 14 gauge galvanized. • Discharge Louvers: 14 and 18 gauge galvanized.

UNIT AND ACCESSORIES DIMENSIONS

MDB/MRB 110-130 Dimensions (Vertical Units)

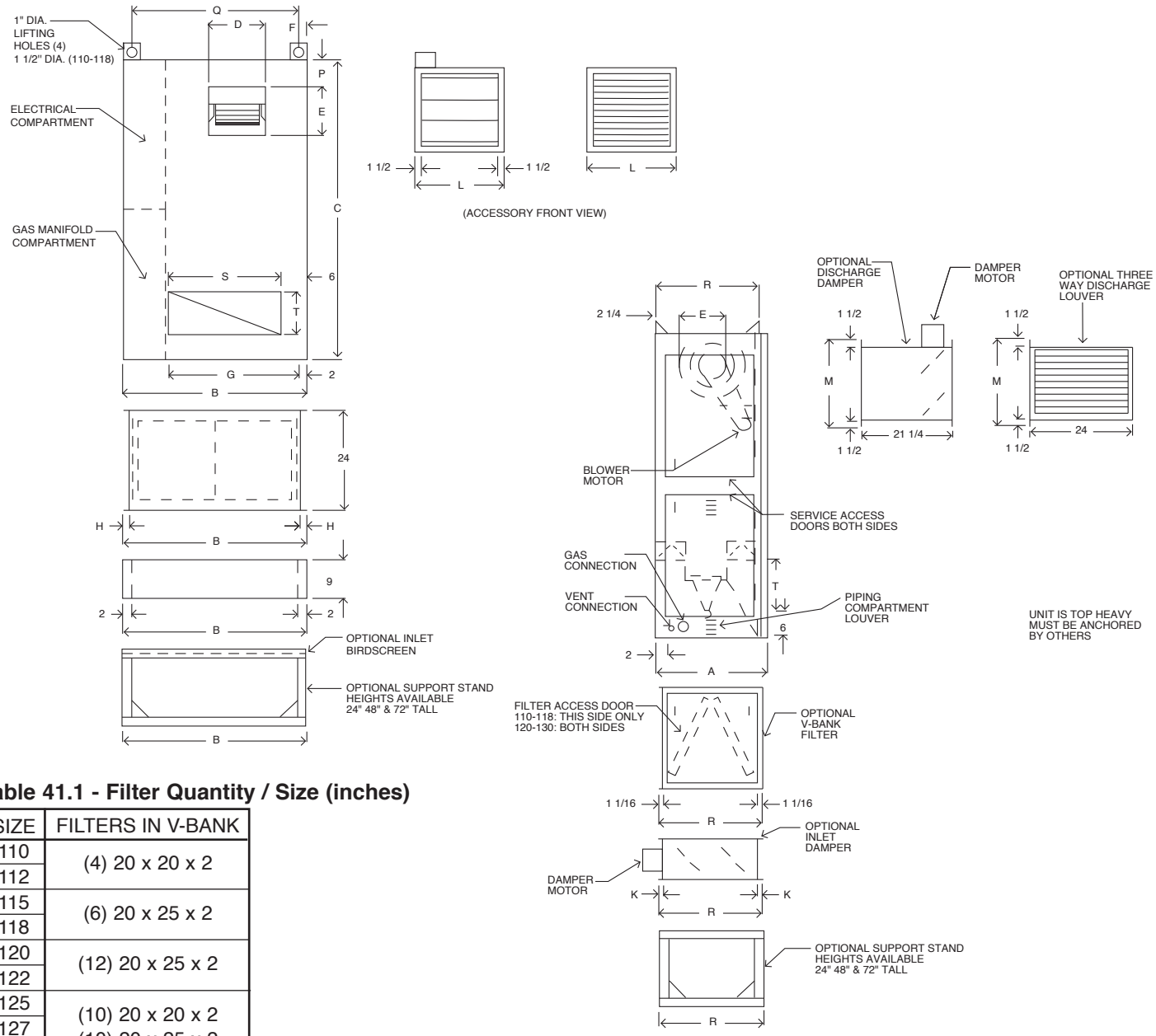


Table 41.1 - Filter Quantity / Size (inches)

SIZE	FILTERS IN V-BANK
110	(4) 20 x 20 x 2
112	
115	(6) 20 x 25 x 2
118	
120	(12) 20 x 25 x 2
122	
125	(10) 20 x 20 x 2 (10) 20 x 25 x 2
127	
130	

Table 41.2 - MDB / MRB Vertical Unit Dimensions (all dimensions in inches)

SIZE	A	B	C	D	E	F	G	H	K	L	M	P	Q	R	S	T
110	24/36 ①	43	71	13 1/4	11 1/2	9 7/8	30	1 1/8	3/4 / 1 1/4 ②	21	20	6 1/4	38	24/36 ①	26	10
112	24/36 ①	43	71	15 3/4	13 9/16	8 5/8	30	1 1/8	3/4 / 1 1/4 ②	21	20	7 3/16	47	24/36 ①	26	10
115	36	52	82	18 3/4	16	11 5/8	39	7/8	1 1/4	26 1/2	25 1/2	8 5/8	47	36	35	12
118	36	52	82	22	19	10	39	7/8	1 1/4	26 1/2	25 1/2	10 9/16	47	36	35	12
120	51	78	96	24 7/8	24 7/8	18 9/16	59	1 5/16	1 3/4	31 1/2	31	11 1/4	75	48	55	14
122	51	78	96	27 3/8	27 3/8	17 5/16	59	1 5/16	1 3/4	31 1/2	31	12 1/4	75	48	55	14
125	63	92	110	31 3/8	31 3/8	22 5/16	73	1 1/16	2 1/4	41 1/2	42	13 1/4	89	60	69	20
127	63	92	110	34 3/8	34 3/8	20 13/16	73	1 1/16	2 1/4	41 1/2	42	15 1/4	89	60	69	20
130	63	92	110	36 7/8	36 7/8	19 9/16	73	1 1/16	2 1/4	41 1/2	42	16 1/4	89	60	69	20

Note: All accessories shipped completely assembled for easy installation. Some accessories shipped separately. All data subject to change.
All dimensions subject to manufacturing tolerances.

MATERIAL GAUGES: Unit Casing: 18 gauge galvanized. • Unit Channel Base: 12 gauge galvanized.
V-Bank: 14 and 18 gauge galvanized. • Damper Blades: 18 gauge galvanized. • Damper Frame: 14 gauge galvanized.
Discharge Louvers: 14 and 18 gauge galvanized.

① 24" for MDB models, 36" for MRB models.

② 3/4" for MDB models, 1 1/4" for MRB models.

ROOF CURB DIMENSIONS

Figure 42.1 - Roof-Curb Dimensions - Size 110-130

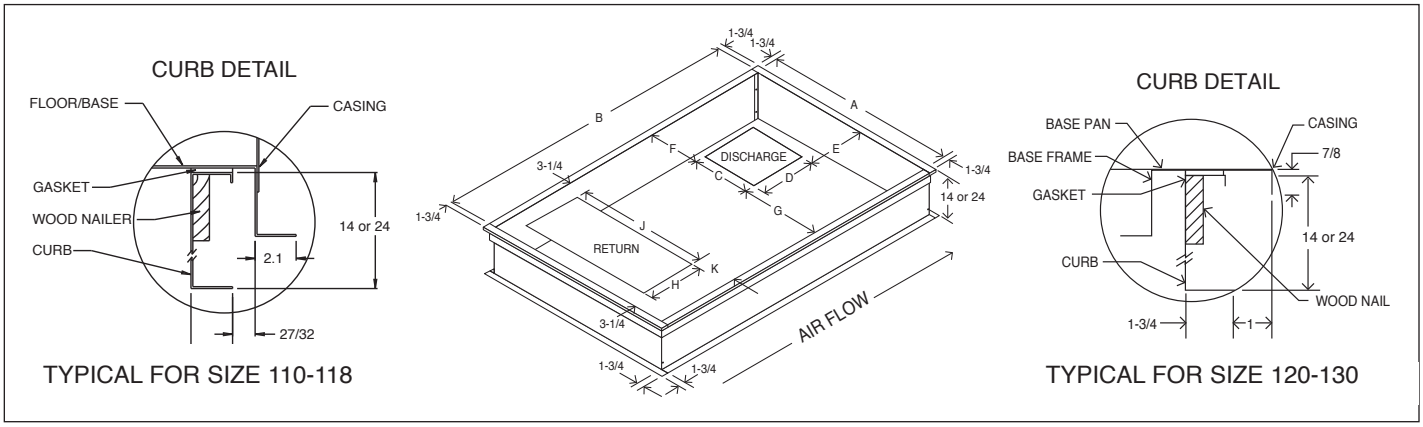


Table 42.1 - Roof-Curb Dimensions - Size 110-130 (inches)

Model Size	Curb Inside Dimensions		Discharge Air Dimensions (optional)					Return Air Dimensions (optional)			Gasket Length (Feet)	Curb Weight (lbs)	
	A	B	C	D	E	F	G	H	J	K		14" High	24" High
110	37 1/2	65 1/2	13 1/4	11 1/2	3 1/2	7 1/8	17 1/8	10	26	8 1/4	19	115	180
112	37 1/2	65 1/2	15 3/4	13 9/16	4 7/16	5 7/8	15 7/8						
115	46 1/2	76 1/2	18 3/4	16	5 7/8	8 7/8	18 7/8	12	35	8 1/4	23	140	215
118	46 1/2	76 1/2	22	19	7 13/16	7 1/4	17 1/4						
120	72 1/2	90 1/2	24 7/8	24 7/8	8 1/2	16 13/16	30 13/16	14	55	14 1/4	29	220	375
122	72 1/2	90 1/2	27 3/8	27 3/8	9 1/2	14 9/16	30 9/16						
124	72 1/2	90 1/2	28 3/8	31 3/8	10 1/2	14 1/16	30 1/16	n/a	n/a	n/a			
125	86 1/2	104 1/2	31 3/8	31 3/8	10 1/2	19 9/16	35 9/16	20	69	14 1/4	34	240	410
127	86 1/2	104 1/2	34 3/8	34 3/8	12 1/2	18 1/16	34 1/16						
130	86 1/2	104 1/2	36 7/8	36 7/8	13 1/2	16 13/16	32 13/16						

Figure 42.2 - Roof-Curb Dimensions - Size 220-230

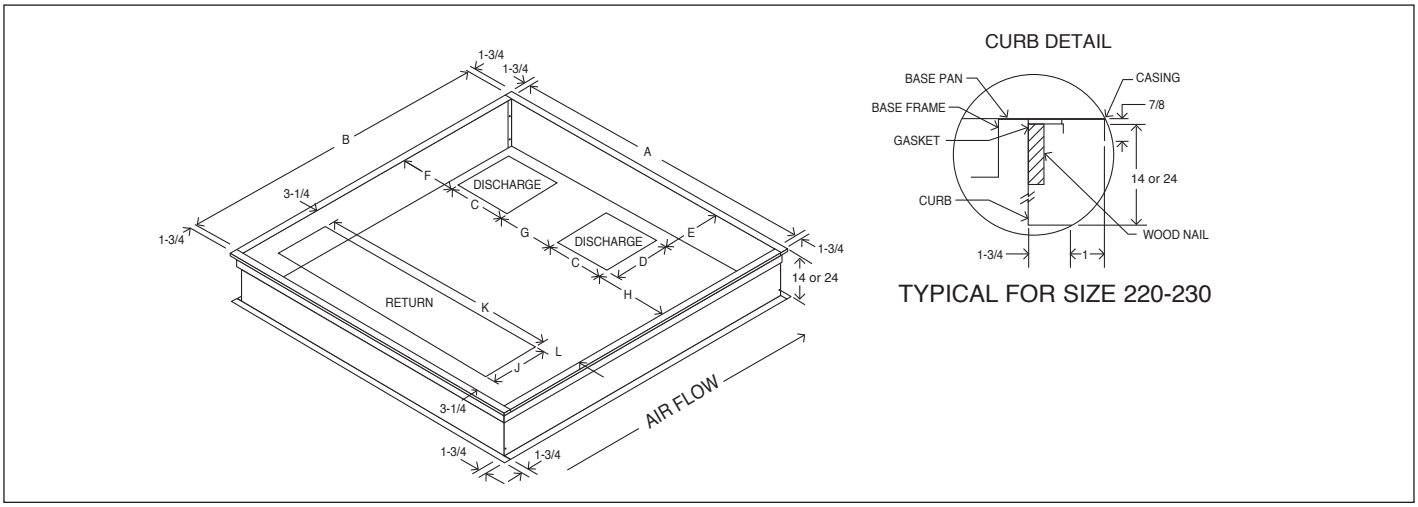


Table 42.2 - Roof-Curb Dimensions - Size 220-230 (inches)

Model Size	Curb Inside Dimensions		Discharge Air Dimensions (optional)					Return Air Dimensions (optional)				Gasket Length (Feet)	Curb Weight (lbs)	
	A	B	C	D	E	F	G	H	J	K	L		14" High	24" High
220	124 1/2	90 1/2	24 7/8	24 7/8	8 1/2	13 5/16	32 1/8	29	14	107	14	38	285	485
222	124 1/2	90 1/2	27 3/8	27 3/8	9 1/2	12 1/16	29 5/8							
225	148 1/2	104 1/2	31 3/8	31 3/8	10 1/2	16 1/16	37 5/8	32	20	131	14	44	315	540
230	148 1/2	104 1/2	36 7/8	36 7/8	14	13 5/16	32 1/8							

EVAPORATIVE COOLING UNIT DIMENSIONS

Figure 43.1 - Evaporative Cooling Module

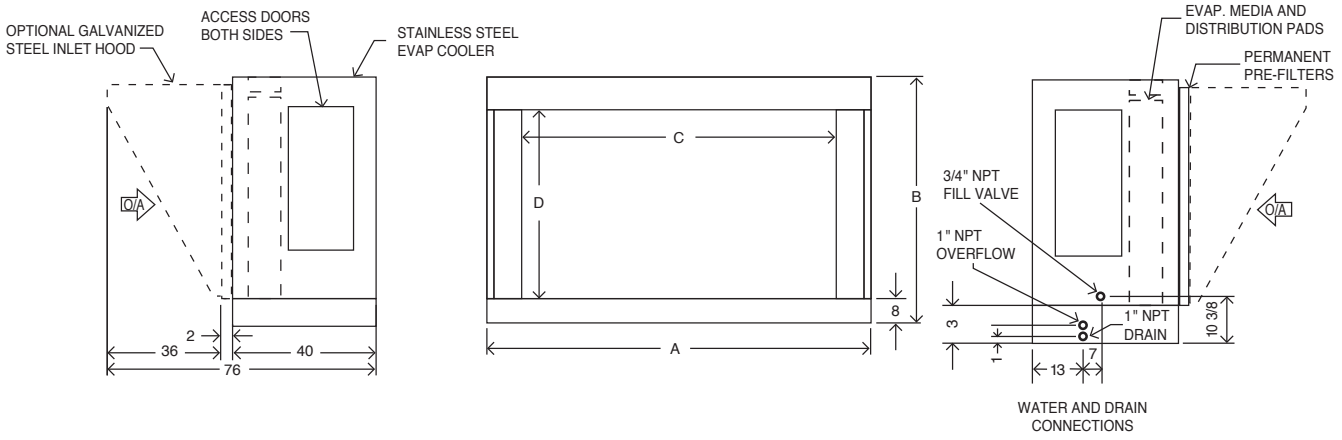


Table 43.1 - Evaporative Cooling Specifications

Model Size	Evaporative Cooler						2" Pre-Filters				12" Evaporative Media				2" Dist. Pad		Weight (Lbs.)		
	A	B	C	D	CFM Range		Qty	Size (L x H)	Face Area (sq ft)	Max. Vel. (FPM)	Qty	Size (W x H)	Face Area (sq ft)	Max Vel. (FPM)	Qty	Size (W x H)	Ship	Oper	Hood
					Min	Max													
110	48	47	39	17	1,600	3,300	6	16 x 20	13.33	248	4	12 x 36	12.00	275	1	12 x 48	265	525	62
112	48	47	39	17	2,000	4,700	6	16 x 20	13.33	353	4	12 x 36	12.00	392	1	12 x 48	265	525	62
115	60	59	48	29	3,000	6,500	6	20 x 25	20.83	312	5	12 x 36	15.00	433	1	12 x 48	395	720	75
118	60	59	48	29	3,500	10,000	6	20 x 25	20.83	480	5	12 x 48	20.00	500	1	12 x 48	395	720	75
120	84	71	74	41	6,000	13,500	3	20 x 20	35.00	386	7	12 x 60	35.00	386	1	12 x 60	610	1065	105
							12	16 x 20							1	12 x 24			
122	84	71	74	41	8,000	16,500	3	20 x 20	35.00	471	7	12 x 60	35.00	471	1	12 x 60	610	1065	105
							12	16 x 20							1	12 x 24			
124	84	71	74	41	10,000	21,500	3	20 x 20	35.00	614	7	12 x 60	35.00	614	1	12 x 60	610	1065	105
							12	16 x 20							1	12 x 24			
125	108	71	88	53	10,000	21,500	9	20 x 20	45.00	478	9	12 x 60	45.00	478	1	12 x 48	755	1340	110
							9	16 x 20							1	12 x 60			
127	108	83	88	53	12,000	26,000	9	20 x 25	56.25	462	9	12 x 72	54.00	481	1	12 x 48	835	1420	125
							9	16 x 25							1	12 x 60			
130	108	83	88	53	14,000	30,000	9	20 x 25	56.25	533	9	12 x 72	54.00	556	1	12 x 48	835	1420	125
							9	16 x 25							1	12 x 60			
220	144	71	126	41	18,000	27,000	12	16 x 20	60.00	450	12	12 x 60	60.00	450	2	12 x 72	1065	1845	140
							12	20 x 20											
222	144	71	126	41	25,000	33,000	12	16 x 20	60.00	550	12	12 x 60	60.00	550	2	12 x 72	1065	1845	140
							12	20 x 20											
225	180	95	150	53	30,000	46,000	9	20 x 25	106.25	433	15	12 x 72	105.00	438	3	12 x 60	1735	2710	175
							27	20 x 20			15	12 x 12							
230	180	95	150	53	36,000	60,000	9	20 x 25	106.25	565	15	12 x 72	105.00	571	3	12 x 60	1735	2710	175
							27	20 x 20			15	12 x 12							

UNIT AND ACCESSORY WEIGHTS

Figure 44.1 - Unit Weights

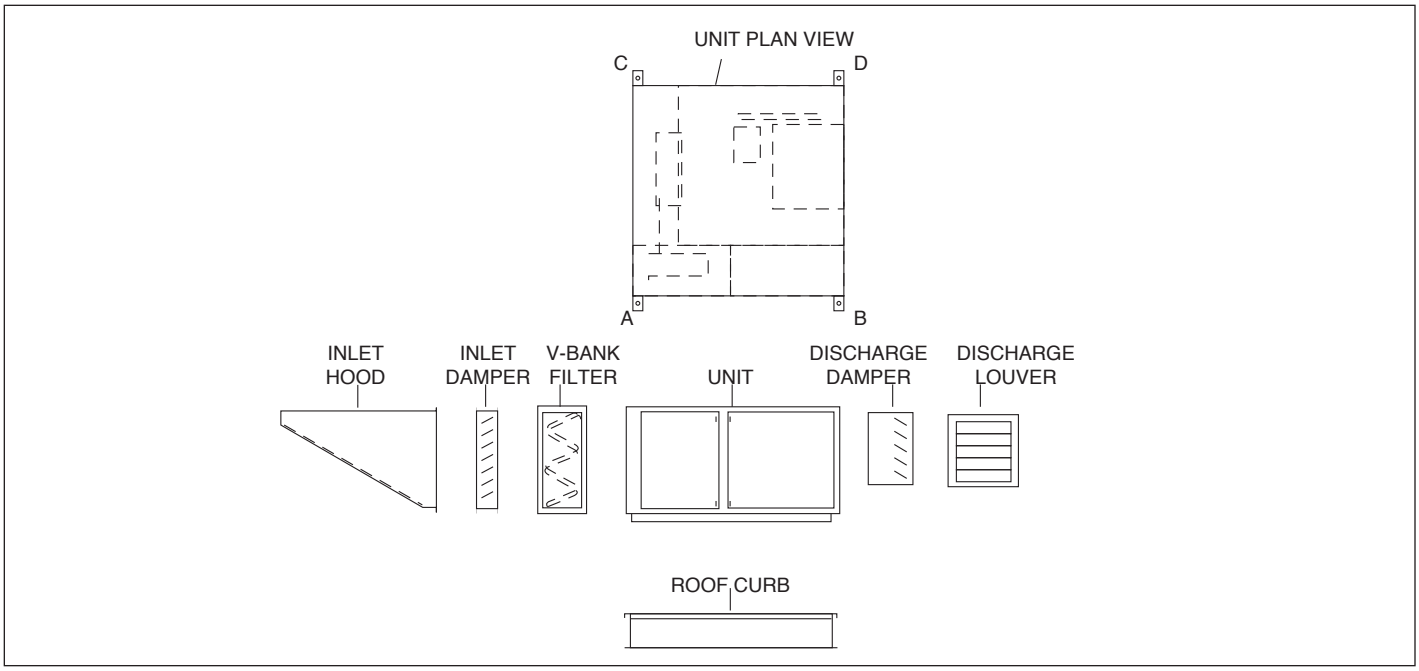


Table 44.1 - Unit Weights (all weight in pounds)

Model Type	Digit 7	Digit 19	110	112	115	118	120	122	124	125	127	130	220	222	225	230
MDB	A-F	A or B	440	500	800	850	1200	1275	1300	1655	1725	1805	1850	2050	2620	2795
		C	475	535	850	900	1260	1335	n/a	1730	1800	1880	2100	2300	2895	3070
	G-J	A or B	480	540	850	900	1350	1425	n/a	1905	1975	2055	n/a	n/a	n/a	n/a
MRB	A-F	A or B	555	615	885	935	1345	1420	n/a	1880	1950	2030	2070	2270	2925	3100
		C	590	650	935	985	1405	1480	n/a	1955	2025	2105	2320	2520	3200	3375
Weight Distribution		A	125	140	220	235	325	345	350	445	465	490	510	570	725	780
		B	100	120	200	210	300	315	325	400	415	430	395	435	610	645
		C	90	100	160	170	250	265	270	365	380	395	435	475	560	590
		D	125	140	220	235	325	345	350	445	465	490	510	570	725	780

Table 44.2 - Accessory Weights (all weight in pounds)

	Model Size					
Accessory	**110, 112**	**115, 118**	**120, 122, 124**	**125, 127, 130**	**220, 222**	**225, 230**
Inlet Hood	80	125	165	220	235	385
Inlet Damper	70	95	170	230	260	380
V-Bank Filter Section	100	135	210	280	300	430
Discharge Damper	60	80	95	135	210	285
Discharge Louver	80	95	115	150	225	310
14" Roof Curb	115	140	220	240	285	315
24" Roof Curb	180	215	375	410	485	540
24" High Vertical Unit Inlet Stand	55	70	180	225	-	-
48" High Vertical Unit Inlet Stand	75	90	220	265	-	-

Table 44.3a - Approximate Motor Weights (all weight in pounds)

HP	3/4		1		1-1/2		2		3		5		7-1/2	
Motor Type	ODP	TE	ODP	TE	ODP	TE	ODP	TE	ODP	TE	ODP	TE	ODP	TE
Weight	25	25	40	40	40	45	50	50	78	80	90	100	150	145

Table 44.3b - Approximate Motor Weights (all weight in pounds)

HP	10		15		20		25		30		40		50	
Motor Type	ODP	TE	ODP	TE	ODP	TE	ODP	TE	ODP	TE	ODP	TE	ODP	TE
Weight	220	160	310	240	360	250	425	500	485	525	580	510	710	775

MAINTENANCE

⚠ CAUTION

When using a drill bit to clean the burner gas ports, do not distort or enlarge the ports. Do not use a power drill.

All heating equipment should be serviced before each heating season to assure proper operation. The following items may be required to have a more frequent service schedule based on the environment in which the unit is installed, and how long the equipment is operated.

Blower Assembly

The blower assembly includes the fan bearings, drive sheaves, and drive belts.

Belt tension should be rechecked shortly after the unit has been installed to check for belt stretching.

After the initial start-up period, monthly checks are recommended.

Blower bearings should be checked and lubricated monthly if the bearings are not of the permanently-lubricated type. On units provided with spider bearings, the bearings are permanently lubricated and should not require additional lubrication. Units provided with pillow block bearings are also supplied with permanent lubrication; however, see vendor's literature supplied with unit for lubrication recommendations.

Bearings should be checked for any unusual wear and replaced if necessary. Also make sure bearings are secure.

Drive sheaves should be checked at the same time the bearings are inspected. Check to make sure the pulleys are in alignment and are securely fastened to the blower and motor drive shafts.

Filters

If the unit is supplied with a dirty filter switch and light, clean or replace the filters any time the dirty filter light comes on. See pages 38-41 for quantities and sizes.

Units that do not have the optional dirty filter switch and light should have the filters checked monthly. Clean or replace if necessary. In dirty atmospheres, filter maintenance may be required more often.

Burners

Generally, direct-fired burners tend to be self-cleaning; however, if the unit is installed in a severely dirty environment, a periodic cleaning of the burner may be required.

Depending on the size of the burner, it may not be practical to attempt to remove the burner from the unit for cleaning. Use the following steps to clean the burner.

1. Turn off all gas and power. Remove the pilot and ignitor assembly from the burner.
2. Break the gas union at the burner and isolate the burner piping from the manifold piping.
3. Seal the open end of the manifold piping with duct tape or other means to prevent dirt from entering the manifold pipe and/or gas controls.
4. Using a high-pressure air hose (40 to 80 PSI) flush the burner gas ports from the flame side of the burner.

   Continue to flush the burner until all dust particles are removed.

Note: If air pressure alone is not sufficient to clean the burner gas ports, the ports may be cleaned by using the appropriately sized bit from a NUMBERED DRILL SET.

Check the manufacturer's name stamped on the burner AND check the type of gas the unit was designed to use. The gas type can be found on the unit's rating plate. With this information, use the following table to determine the correct numbered drill bit size. Push the bit by hand through the gas ports to clean them.

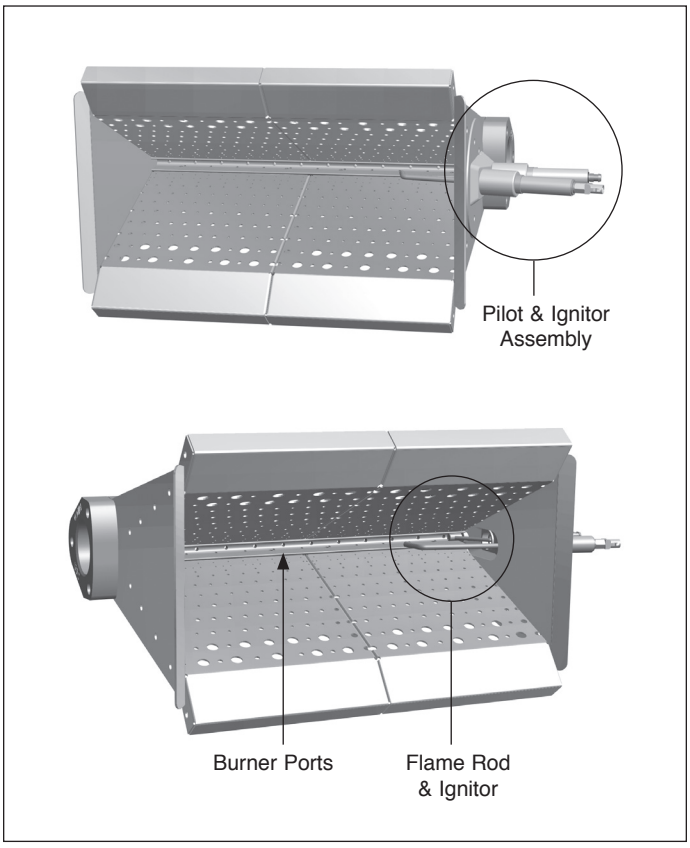
Burner	Gas Type	Drill #
Midco	Natural and Propane	#31

5. Remove the protective cover that was placed on the manifold piping in Step 3 and reconnect the gas union.
6. Reassemble pilot and ignitor assembly to the burner.
7. After cleaning and re-assembly, use a soap/water solution to check for gas leaks in the piping.
8. Restore power and gas to the unit.

Gas and Electric Controls

Inspect for general cleanliness and tightness of electric and mechanical connections.

Figure 45.1 - Midco Burner Assembly



MAINTENANCE / SERVICE AND TROUBLESHOOTING

Care of Heater for Extended Shutdown Periods

If the unit is to be shut down for an extended period of time, the following precautions should be followed.

1. Turn off all manual shutoff valve(s) in the gas train of the unit, and in the gas supply line to the unit.
2. Turn off the electric supply to the unit at the unit's disconnect. Lock the disconnect to prevent tampering.
3. If the unit is supplied with filters, remove and store the filters.
4. Protect outside air openings to prevent the unit from being soiled.

⚠ WARNING

When servicing or repairing this equipment, use only factory-approved service replacements parts. A complete replacement parts list may be obtained by contacting the factory. Refer to the rating plate on the unit for complete unit model number, serial number, and company address. Any substitution of parts or controls not approved by the factory will be at owner's risk.

⚠ CAUTION

Do not reuse any mechanical or electrical component which has been wet. Such component must be replaced.

IMPORTANT

To check most of the Possible Remedies in the troubleshooting guide listed in Table 46.1, refer to the applicable sections of the manual.

SERVICE AND TROUBLESHOOTING

Table 46.1 - Service & Troubleshooting

Trouble	Possible Cause	Possible Remedy
A. Power Failure	1. Disconnect not turned on.	1. Turn to disconnect.
	2. Blown fuses.	2. Check and replace.
	3. Main to unit disconnect not on.	3. Turn on power at main.
B. Dampers Won't Operate	1. Disconnect not turned on.	1. Turn on disconnect.
	2. Blown fuses.	2. Check and replace.
	3. Main to unit disconnect not on.	3. Turn on power at main.
	4. Failed damper motor.	4. Check and/or replace.
	5. Loose wiring to motor.	5. Check and tighten.
	6. Damper linkage binding.	6. Check and clear.
C. Motor Failure	1. Disconnect not turned on.	1. Turn on disconnect.
	2. Blown fuses.	2. Check and replace.
	3. Main to unit disconnect not on.	3. Turn on power at main.
	4. Failed motor.	4. Check and/or replace.
	5. Loose wiring to motor.	5. Check and tighten.
	6. Starter fuses blown.	6. Check and/or replace.
	7. Motor overloaded.	7. Check for proper speed.
	8. Improper supply voltage.	8. Check and correct.
	9. Motor overheating.	9. Check firing rate of unit.
D. Blower Not Turning	1. See Problems "A" and "C"	1. See Problems "A" and "C"
	2. Broken drive belt(s).	2. Check and replace.
	3. Bearings seized.	3. Check and replace.
	4. Improper supply voltage.	4. Check and correct.
E. No Burner Operation	1. See Problems "A" thru "D"	1. See Problems "A" thru "D"
	2. Damper end switch not functioning.	2. Check and/or replace.
	3. Failed air flow switch.	3. Check and/or replace.
	4. Loose wiring connection at air proving.	4. Check and tighten.
	5. No pilot.	5. See Problem "F"
	6. Pilot not proving.	6. See Problem "F"
	7. Flame safeguard in lockout mode.	7. Check and reset.
	8. High limit tripped.	8. Check and/or replace.
	9. Too high or low gas pressure.	9. Check pressure switches and gas pressure.
	10. Failed control transformer.	10. Check and/or replace.
	11. Blown control transformer fuse.	11. Check and/or replace.
	12. Failed or malfunctioning main gas valve(s).	12. Check and/or replace
	13. Faulty or failed freeze stat or inlet on/off stat.	13. Check and/or replace.
	14. Failed safeguard control.	14. See vendors instructions shipped with unit.
	15. Airflow too low, low airflow proving switch is open.	15. Check for reason of insufficient airflow and current.
	16. Airflow too high, high airflow cutoff switch is open.	16. Check for reason of excessive airflow and correct

If the preceding service diagnostics do not solve your problem, contact your local Modine Manufacturing sales representative for further assistance. Please be sure to have the complete model number and serial number from the unit's rating plate available before calling for service.

SERVICE AND TROUBLESHOOTING

Trouble	Possible Cause	Possible Remedy
F. No Pilot	1. No gas to pilot.	1. Check hand valve and pilot solenoid valve.
	2. Dampers not functioning.	2. See Problem “B”
	3. Pilot tube plugged or damaged	3. Check and repair/or replace.
	4. Freeze stat failure.	4. Check and/or replace.
	5. Inlet On/Off stat failure.	5. Check and/or replace.
	6. Flame safeguard in lockout	6. Check and reset.
	7. Failed flame safeguard.	7. See vendor’s instructions shipped with unit.
	8. Failed air flow switch	8. Check and/or replace.
	9. Too high or low gas pressure.	9. Check pressure switches and gas pressure.
	10. See Problem “E” – No Burner	10. See Problem “E” Operation.
G. Pilot Will Not Prove	1. Inadequate signal to safeguard control.	1. Check micro-amps or Vdc. See vendor literature for type of flame safeguard supplied with unit.
	2. Insufficient gas pressure to pilot.	2. Check and adjust.
	3. Loose lead wires.	3. Check and correct.
	4. Soiled flame rod.	4. Clean and/or replace.
	5. Moisture on flame rod lead.	5. Check and dry leads.
	6. Defective flame rod.	6. Check or replace. See vendor literature shipped with unit.
	7. Defective flame safeguard.	7. Check or replace. See vendor literature shipped with unit.
	8. Short in sensing leads.	8. Check and repair.
	9. Excessive air velocity across burner.	9. Check burner velocity and correct.
H. Erratic Temperature	1. Defective temperature selector or sensor.	1. See vendor literature shipped with unit.
	2. Temperature sensor subject to poor air flow or located in drafty area.	2. Check sensor location and move if required.
	3. Discharge sensor blocked by duct insulation.	3. Check and remove blockage
	4. Faulty amplifier or proportioning motor.	4. See vendor literature shipped with unit.
I. Unable to Achieve High Fire.	1. Low gas supply pressure.	1. Check and adjust.
	2. Modulating controls improperly set.	2. See vendor literature shipped with unit.
	3. Faulty temperature sensor.	3. Check and/or replace.
	4. Faulty amplifier or proportioning motor.	4. See vendor literature shipped with unit.
J. Unable to Achieve Low Fire.	1. Modulating controls improperly set.	1. See vendor literature shipped with unit.
	2. Faulty temperature sensor.	2. Check and/or replace
	3. Faulty amplifier or proportioning motor.	3. See vendor literature shipped with unit.
K. No Gas Flow	1. Manual gas valve(s) closed.	1. Open manual gas valve(s).
	2. See Problem “E”, Items 2 thru 14	2. See Problem “E”, Items 2 thru 14
L. Unable to Achieve Desired Discharge Temperature, or Space Temperature	1. Temperature sensors improperly set or faulty.	1. Adjust or replace.
	2. Improper gas supply pressure.	2. Check and correct.
	3. Faulty amplifier or proportioning motor.	3. See vendor literature shipped with unit.
	4. Air flow too high.	4. Check blower speed and/or burner velocity differential pressure.
	5. Burner capacity undersized.	5. Check rating plate for conformance to design specifications.
M. Floating 75/25 Damper Functioning Incorrectly or Not Functioning damaged, or disconnected.	1. Defective building pressure switch.	1. Check and/or replace.
	2. Pressure switch improperly set.	2. See vendor literature shipped with unit.
	3. Pressure switch pick-up tubes blocked,	3. Check and repair or reconnect.
	4. Outdoor pressure pick-up tube not routed to outdoors.	4. Route tube to outdoors.
	5. Faulty damper motor.	5. Check and/or replace.
	6. Dampers binding.	6. Check and repair.
	7. Damper linkages loose.	7. Check and retighten.
	8. No power to damper motor.	8. Check power supply to motor.
N. Two Position 50/50, 60/40, 75/25 Dampers Not Functioning	1. Damper position selector switch or relay defective.	1. Check and/or replace.
	2. Faulty damper motor.	2. Check and/or replace.
	3. Dampers binding.	3. Check and repair.
	4. Damper linkages loose.	4. Check and tighten.
	5. No power to damper motor.	5. Check power supply to motor.

If the preceding service diagnostics do not solve your problem, contact your local Modine Manufacturing sales representative for further assistance.
Please be sure to have the complete model number and serial number from the unit’s rating plate available before calling for service.

CONTROL DEFINITIONS

Air Flow Proving Switch - Monitors air flow to prevent burner from operating if air flow across burner is too low.

Alarm Light - A light located on the remote control panel which when lit indicates a flame failure.

Amplifier, Flame Safeguard - Plug in component of flame safeguard control which is used to match the flame detection device (flame rod), and to set the flame safeguard flame response time.

Amplifier, Temperature Control - Logic circuit to control firing rate on units supplied with Maxitrol control systems (Systems 14,44, SC11).

Blower Light - When lit indicates that the blower motor is energized. (Optional)

Blower Motor - Main fan motor that drives the blower wheel via belts and pulleys.

Building Pressure Control - Includes a building photohelic pressure switch, and a pressure gauge. Used to position the floating return and fresh air dampers on 75/25 style units or adjust the VFD speed to maintain constant building pressure.

Burner By-Pass Damper - Used on return air units. The by-pass damper is used to by-pass outside air around the burner.

Burner Relay - Part of flame safeguard control that allows main valves to open after pilot is proved.

Control Transformer - A transformer that is used to provide 115v power to the burner controls.

Dirty Filter Light - A light mounted on the remote control panel that turns on if and excessive pressure drop across the filters is detected. (Optional)

Dirty Filter Pressure Switch - A pressure switch used to monitor sense pressure drop across the filters. (Optional)

Discharge Air Damper - A damper located at the discharge of the unit. Used to shut off outside air when unit is not operating. (Optional)

Disconnect Switch - A switch that is used to manually make or break electrical power to the unit.

Flame Rod - A sensor that monitors the pilot and main flame and provides an electric signal to the flame safeguard control to allow main burner ignition.

Flame Safeguard Control - A sequencing relay that controls and monitors pilot and main burner ignition.

Freeze Stat - Used to monitor discharge air temperature from unit. Shuts unit down if discharge air temperature falls below set point. (Optional)

High/Low Gas Pressure Switch - Monitors gas pressure at burner and prevents burner operation if excessive gas pressure is sensed. Monitors inlet gas pressure and prevents burner operation if low gas pressure is detected. (Optional)

High Temperature Limit Control - Used to monitor heated air temperature and turns off gas to burner if excessive temperatures are experienced.

Ignitor Generator - Generates a high voltage power source (6000 volts) for pilot spark ignitor.

Inlet Air Damper - Damper located on the inlet air side of the unit. Used to shut off outside air when the unit is not operating. (Optional)

Main Solenoid Gas Valve - Electric on/off gas valve that allows flow of gas to the modulating gas valve.

Manual Reset Button, Flame Safeguard Control - Located on the flame safeguard control and is used to restart the burner if a flame failure has occurred.

Manual Reset Button, High Limit Control - Located on the high limit control and is used to restart the unit if an abnormal high temperature failure has occurred.

Mild Temperature Inlet On/Off Stat - Monitors inlet air to the unit and serves as a positive burner shut-off when outdoor temperature exceeds set point. Used to prevent burner operation when heat is not required. (Optional)

Modulating Gas Valve - Located downstream of the on/off solenoid valve(s) and is used to modulate the gas flow to the burner in response to temperature controls.

Motor Starter - Used to start motor when unit is turned on.

Pilot Solenoid Gas Valve - Electric on/off gas valve that allows gas flow to the pilot when the burner is energized.

Spark Ignitor - Part of the pilot assembly. It is used to generate a spark to light the pilot gas

Temperature Selector - Temperature dial that is used to set the desired discharge air temperature, or space temperature set point.

Temperature Sensor - A device that monitors the discharge air temperature or space temperature, and modulates the modulating gas valve accordingly

September, 2006

Direct Gas-Fired Make-Up Air Unit Start-Up Report

Job Name:	Date:
Address:	Model No.:
City & State:	Order No.:
Start-Up Check List "**ALL ITEMS MUST BE CHECKED**"	Serial No.:

1.	All shipping straps, braces, tie downs removed?	☐ Yes	☐ No
2.	Unit installed level and secure?	☐ Yes	☐ No
3.	Gas burner properly located and aligned?	☐ Yes	☐ No
4.	Blower and motor alignment okay?	☐ Yes	☐ No
5.	Bearings aligned and tight on shaft/bearing supports?	☐ Yes	☐ No
6.	Electrical connections checked and secure?	☐ Yes	☐ No
7.	Gas piping checked, tightened if necessary, and free of leaks?	☐ Yes	☐ No
8.	Any visible damage to unit? Describe: _____ If damaged, was the damage repaired?	☐ Yes ☐ Yes	☐ No ☐ No
9.	Air inlet and discharge checked for obstructions?	☐ Yes	☐ No
10.	Bearings checked for proper lubrication?	☐ Yes	☐ No
11.	Filters in place and correct to direction of air flow?	☐ Yes	☐ No
12.	Belt tension checked? Yes	☐ No	☐
13.	Electric supply to unit: _____ Volts, _____ Hz, _____ Phase	☐ Done	
14.	Gas supply to unit: _____ Natural, _____ Propane	☐ Done	
15.	Gas supply pressure to unit: _____ " W.C., _____ PSIG	☐ Done	
16.	Inlet and/or discharge dampers operating correctly?	☐ Yes	☐ No
17.	Blower rotation correct? Yes	☐ No	☐
18.	Blower speed: Hi Speed _____ RPM, Lo Speed _____ RPM	☐ Done	
19.	Motor speed: Hi Speed _____ RPM, Lo Speed _____ RPM	☐ Done	
20.	Is unit noisy? Excessive vibration? If so, has the problem been corrected?	☐ Yes ☐ Yes	☐ No ☐ No
21.	Motor voltage (High Speed): L1-L2_____V, L1-L3 _____V, L2-L3_____V Done	☐	
22.	Motor amps (High Speed): L1 _____ Amp, L2 _____ Amp, L3 _____ Amp Done	☐	
23.	Pilot sensor amps: _____ Flame Rod, _____ UV, _____ μAmp, _____ Vdc Done	☐	
24.	Flame safeguard functioning correctly? Time required to go into lockout: _____ Seconds	☐ Yes	☐ No
25.	Air flow proving switch and profile velocity differential pressure checked? Yes No Differential velocity pressure reading: High Speed_____"w.c., Low Speed_____"w.c. Outdoor air temperature at time of test: °F	☐	☐
26.	Low fire check: Does burner light off smoothly and across full burner le ngth? High fire check: Is flame clean and stable, and does flame modulate in response to temperature control(s)? ____ Burner manifold pressure reading:_____ "w.c.	☐ Yes ☐ Yes	☐ No ☐ No
27.	Gas input checked? At maximum firing rate: _____ Btu/Hr At minimum firing rate: -_____ Btu/Hr	☐ Done	
28.	Burner by-pass and return air damper operating correctly (if provided)? Yes No	☐	☐

Name(s) of Customer/Owner instructed in operation and maintenance of unit: _____

_____

Comments: _____

_____

Start-Up Company Name: _____ Phone: _____

Signature: _____ Date: _____

REPLACEMENT PARTS ORDERING

Ordering

When servicing, repairing or replacing parts on these units, locate the serial plate of the unit and always give the complete model number and serial number from the serial plate. The serial plate is located on the door of the electrical control box.

Figure 50.1 - Serial Plate Example ①

MODINE

DIRECT INDUSTRIAL AIR HEATER
FOR INDUSTRIAL/COMMERCIAL USE
FOR OUTDOOR INSTALLATION ONLY

C ETL LISTED US
Intertek

MODINE MANUFACTURING
1500 DEKOVEN AVENUE
RACINE, WI 53403

PHONE 800-828-4328

b -2002 NON-RECIRCULATING DIRECT INDUSTRIAL AIR HTR.

MODEL NUMBER MDB110AC0275AA1CA4AB2DA	MAX. BTU/HR INPUT		211000	MAKE-UP AIR MODE: MIN. AMBIENT AIR TEMP: -30°F MAX. DISCHCHARGE TEMP: 105°F MAX. AIR TEMP RISE: 115°F
SERIAL NUMBER 999999-06-1004	MIN. BTU/HR INPUT		11000	
FUEL NAT. GAS ***1050*** BTU/CUFT	SYSTEM	VOLTAGE	208V/60Hz/3Ph	START UP INSTRUCTIONS (1) TURN OFF ALL POWER. (2) CLOSE ALL GAS VALVES. (3) WAIT 5 MINUTES (4) OPEN ALL GAS VALVES AND TURN ON ALL POWER. (5) SET TEMPERATURE CONTROL TO CALL FOR HEAT. (SYSTEM WILL START AUTOMATICALLY)
INLET SUPPLY PRESSURE 14 "W.C. MAX / 8 "W.C. MIN	MOTOR	HORSEPOWER	1	
MIN. SUPPLY PRESSURE FOR MAX. INPUT ADJUSTMENT 8 "W.C.		VOLTAGE	208	
NORMAL MANIFOLD PRESSURE (AT BURNER) AT MAX. INPUT 2.5 "W.C.		HERTZ/PHASE	60/3	
BLOWER SPEED 1121 RPM PROFILE VELOCITY ***2750*** FPM		AMPS	3.1	SHUT DOWN INSTRUCTIONS (1) TURN OFF ALL POWER. (2) CLOSE ALL GAS VALVES.
EQUIPPED FOR OPERATION AT AN AIR FLOW OF 1700 SCFM AGAINST AN EXTERNAL STATIC PRESSURE OF 0.66 INCH(ES) WATER COLUMN. SEE MANUFACTURER'S INSTRUCTIONS FOR OTHER AIR FLOW CAPACITIRES.	CONTROLS	VOLTAGE	24V/60Hz/1Ph	
		AMPS	1.3	
MIN. CLEARANCE TO COMBUSTIBLE MATERIAL FROM TOP AND ALL SIDES 6 INCHES. BOTTOM 0 INCHES WITH 4 INCH BASE RAIL.				

IN AIRPLANE HANGARS INSTALL IN ACCORDANCE WITH THE STANDARD FOR AIRCRAFT HANGARS ANSI/NFPA 409. IN PUBLIC GARAGES INSTALL IN ACCORDANCE WITH THE STANDARD FOR PARKING STRUCTURES ANSI/NFPA 88A OR THE STANDARD FOR REPAIR GARAGES ANSI/NFPA 88B.

FOR YOUR SAFETY
THE USE AND STORAGE OF GASOLINE OR OTHER FLAMMABLE VAPORS AND LIQUIDS IN OPEN CONTAINERS IN THE VICINITY OF THIS APPLIANCE IS HAZARDOUS.

WARNING
IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE PROPERTY DAMAGE, INJURY, OR DEATH. READ THE INSTRUCTIONS THOROUGHLY BEFORE INSTALLING OR SERVICING THIS EQUIPMENT.

5H78679B

① MRB units are certified for use in the U.S. only and will be labeled with the ETL-US symbol only.

MODEL NOMENCLATURE

1,2	3	4	5,6	7	8	9,10,11,12	13	14	15	16	17	18	19	20	21	22	23
PT	DS	BQ	BS	UC	CF	MBTU	GT	GC	I	MO	AC	SV	BT	HP	MT	SA	PA

1,2 - Product Type (PT)
MD - 100% Make Up Air
MR - Return Air

3 - Design Sequence (DS)
B - Internally Assigned

4 - Blower Quantity (BQ)
1 - Single Blower Unit
2 - Twin Blower Unit

5,6 - Blower Size (in.) (BS)

10 - 10"	22 - 22"
12 - 12"	24 - 25" x 22" (single blower units only)
15 - 15"	25 - 25"
18 - 18"	27 - 27"
20 - 20"	30 - 30"

7 - Unit Configuration (UC) (See Figure 51.1)
A - Horizontal, right access, straight discharge (bottom return on MR)
B - Horizontal, left access, straight discharge (bottom return on MR)
C - Horizontal, right access, bottom discharge (bottom return on MR)
D - Horizontal, left access, bottom discharge (bottom return on MR)
E - Horizontal, right access, top discharge (not available on MR units)
F - Horizontal, left access, top discharge (not available on MR units)
G - Vertical, right access, top discharge (not available on MR units)
J - Vertical, right access, top-right discharge (not available on MR units)

8 - Cabinet Finish and Location of Installation (CF)
A - Unpainted, Outdoor Installation
B - Unpainted, Indoor Installation
C - Painted, Outdoor Installation
D - Painted, Indoor Installation

9, 10, 11, 12 - Maximum Burner Input (MBH) (MBTU)

0275	3850
0400	4125
0550	4400
0825	4675
1000	4950
1100	5225
1375	5500
1650	5775
1925	6050
2200	6325
2475	6600
2750	6875
3025	7150
3300	7425
3575	

Example: If burner rating is 389MBH, 0400 will be used in model number.

13 - Gas Type and Inlet Pressure
A - Natural Gas (8-14")
B - Natural Gas (1-5 psi)
C - Propane Gas (11-14")
D - Propane Gas (1-5 psi)

14 - Gas Control System (GC)
A - Maxitrol 14
B - Maxitrol 44
C - SC11 DDC (4-20 mA)
D - SC11 DDC (0-10 VDC)

15 - Insurance (I)
1 - IRI (standard ETL)
2 - FM less Restriction
3 - FM with Restriction

16 - Additional Manifold Options (MO)
C - High & Low Gas Pressure Switch
N - None

17 - Air Control Option (AC)
A - 100% MUA - Single Speed
B - 100% MUA - Two Speed (Motor or VFD) - Type A
C - 100% MUA - Two Speed (Motor or VFD) - Type B
D - 100% MUA - DDC Control (VFD only) - Type A
E - 100% MUA - DDC Control (VFD only) - Type B
F - Space Pressure Control (MD with VFD or MR) - Type A
G - Space Pressure Control (MD with VFD or MR) - Type B
H - Space Pressure Control (MD with VFD or MR) - Type C
I - Return Air - Fixed 75/25 Dampers - Type A
J - Return Air - Fixed 75/25 Dampers - Type B
K - Return Air - Fixed 75/25 Dampers - Type C
L - Return Air - Fixed 70/30 Dampers - Type A
M - Return Air - Fixed 70/30 Dampers - Type B
N - Return Air - Fixed 70/30 Dampers - Type C

18 - Supply Voltage (SV)

1 - 115/60/1	5 - 230/60/3
2 - 208/60/1	6 - 460/60/3
3 - 230/60/1	7 - 575/60/3
4 - 208/60/3	

19 - Bearings and Vibration Isolation (BT)
A - Spider Bearings - No Vibration Isolation
B - Pillow Block Bearings - No Vibration Isolation
C - Pillow Block Bearings - With Spring Vibration Isolation

20 - Motor HP (HP)

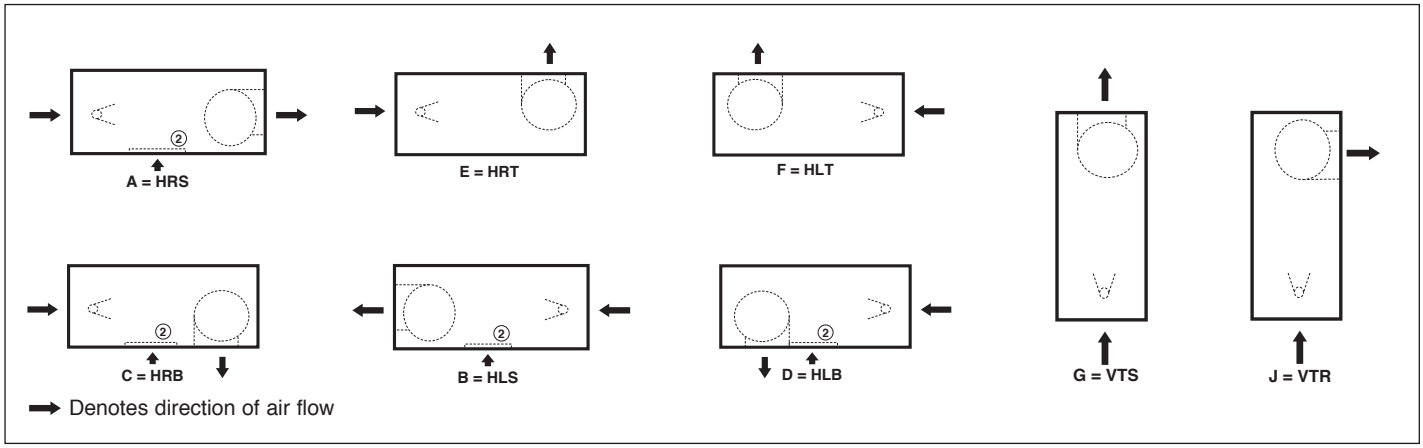
A - 3/4	H - 10
B - 1	I - 15
C - 1.5	J - 20
D - 2	K - 25
E - 3	L - 30
F - 5	M - 40
G - 7.5	N - 50

21 - Motor Type (MT)
1 - ODP
2 - ODP - High Efficiency
5 - TE
6 - TE - High Efficiency

22 - Sheave Arrangement (SA)
A - (see Sheave Tables)

23 - Profile Assembly (PA)
A - (Internally assigned)

Figure 51.1- Unit Configurations ①



① Configurations are shown facing the side of the unit with the gas and electrical controls.
② For models with return air (Series MRB).

COMMERCIAL WARRANTY

Seller warrants its products to be free from defects in material and workmanship, EXCLUSIVE, HOWEVER, of failures attributable to the use of materials substituted under emergency conditions for materials normally employed. This warranty covers replacement of any parts furnished from the factory of Seller, but does not cover labor of any kind and materials not furnished by Seller, or any charges for any such labor or materials, whether such labor, materials or charges thereon are due to replacement of parts, adjustments, repairs, or any other work done. This warranty does not apply to any equipment which shall have been repaired or altered outside the factory of Seller in any way so as, in the judgment of Seller, to affect its stability, nor which has been subjected to misuse, negligence, or operating conditions in excess of those for which such equipment was designed. This warranty does not cover the effects of physical or chemical properties of water or steam or other liquids or gases used in the equipment.

BUYER AGREES THAT SELLER'S WARRANTY OF ITS PRODUCTS TO BE FREE FROM DEFECT IN MATERIAL AND WORKMANSHIP, AS LIMITED HEREIN, SHALL BE IN LIEU OF AND EXCLUSIVE OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, WHETHER ARISING FROM LAW, COURSE OF DEALING, USAGE OF TRADE, OR OTHERWISE, **THERE ARE NO OTHER WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE, WHICH EXTEND BEYOND THE PRODUCT DESCRIPTION CONFIRMED BY BUYER AND SELLER AS OF THE DATE OF FINAL AGREEMENT.**

This warranty is void if the input to the product exceeds the rated input as indicated on the product serial plate by more than 5% on gas-fired and oil-fired units, or if the product in the judgment of SELLER has been installed in a corrosive atmosphere, or subjected to corrosive fluids or gases, been subjected to misuse, negligence, accident, excessive thermal shock, excessive humidity, physical damage, impact, abrasion, unauthorized alterations, or operation contrary to SELLER'S printed instructions, or if the serial number has been altered, defaced or removed.

BUYER AGREES THAT IN NO EVENT WILL SELLER BE LIABLE FOR COSTS OF PROCESSING, LOST PROFITS, INJURY TO GOODWILL, OR ANY OTHER CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND RESULTING FROM THE ORDER OR USE OF ITS PRODUCT, WHETHER ARISING FROM BREACH OF WARRANTY, NONCONFORMITY TO ORDERED SPECIFICATIONS, DELAY IN DELIVERY, OR ANY LOSS SUSTAINED BY THE BUYER.

BUYER'S REMEDY FOR BREACH OF WARRANTY, EXCLUSIVE OF ALL OTHER REMEDIES PROVIDED BY LAW, IS LIMITED TO REPAIR OR REPLACEMENT AT THE FACTORY OF SELLER, ANY COMPONENT WHICH SHALL, WITHIN THE APPLICABLE WARRANTY PERIOD DEFINED HEREIN AND UPON PRIOR WRITTEN APPROVAL, BE RETURNED TO SELLER WITH TRANSPORTATION CHARGES PREPAID AND WHICH THE EXAMINATION OF SELLER SHALL DISCLOSE TO HAVE BEEN DEFECTIVE; EXCEPT THAT WHEN THE PRODUCT IS TO BE USED BY BUYER AS A COMPONENT PART OF EQUIPMENT MANUFACTURED BY BUYER, BUYER'S REMEDY FOR BREACH, AS LIMITED HEREIN, SHALL BE LIMITED TO ONE YEAR FROM DATE OF SHIPMENT FROM SELLER. FOR GAS-FIRED PRODUCTS INSTALLED IN HIGH HUMIDITY APPLICATIONS AND UTILIZING STAINLESS STEEL HEAT EXCHANGERS, BUYER'S REMEDY FOR BREACH, AS LIMITED HEREIN, SHALL BE LIMITED TO TEN YEARS FROM DATE OF SHIPMENT FROM SELLER.

These warranties are issued only to the original owner-user and cannot be transferred or assigned. No provision is made in these warranties for any labor allowance or field labor participation. Seller will not honor any expenses incurred in its behalf with regard to repairs to any of Seller's products. No credit shall be issued for any defective part returned without proper written authorization (including, but not limited to, model number, serial number, date of failure, etc.) and freight prepaid.

OPTIONAL SUPPLEMENTAL WARRANTY

Provided a supplemental warranty has been purchased, Seller extends the warranty herein for an additional four (4) years on certain compressors. Provided a supplemental warranty has been purchased, Seller extends the warranty herein for an additional four (4) years or nine (9) years on certain heat exchangers.

EXCLUSION OF CONSUMABLES & CONDITIONS BEYOND SELLER'S CONTROL

This warranty shall not be applicable to any of the following items: refrigerant gas, belts, filters, fuses and other items consumed or worn out by normal wear and tear or conditions beyond Seller's control, including (without limitation as to generality) polluted or contaminated or foreign matter contained in the air or water utilized for heat exchanger (condenser) cooling or if the failure of the part is caused by improper air or water supply, or improper or incorrect sizing of power supply.

Component Applicable Models	**"APPLICABLE WARRANTY PERIOD"**
Heat Exchangers Gas-Fired Units except PSH/BSH	TEN YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN TEN YEARS FROM DATE OF RESALE BY BUYER OR ANY OTHER USER, WITHIN TEN YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN ONE HUNDRED TWENTY-SIX MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST
Heat Exchangers Low Intensity Infrared Units **Compressors** Condensing Units for Cassettes	FIVE YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN FIVE YEARS FROM DATE OF RESALE BY BUYER OR ANY OTHER USER, WITHIN FIVE YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN SIXTY-SIX MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST
Burners Low Intensity Infrared Units **Other** Components excluding Heat Exchangers, Coils, Condensers, Burners, Sheet Metal	TWO YEARS FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN TWO YEARS FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN THIRTY MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST
Heat Exchangers/Coils Indoor and Outdoor Duct Furnaces and System Units, PSH/BSH, Steam/Hot Water Units, Oil-Fired Units, Electric Units, Cassettes, Vertical Unit Ventilators **Compressors** Vertical Unit Ventilators **Burners** High Intensity Infrared Units **Sheet Metal Parts** All Products	ONE YEAR FROM DATE OF FIRST BENEFICIAL USE BY BUYER OR ANY OTHER USER, WITHIN ONE YEAR FROM DATE OF RESALE BY BUYER IN ANY UNCHANGED CONDITION, OR WITHIN EIGHTEEN MONTHS FROM DATE OF SHIPMENT FROM SELLER, WHICHEVER OCCURS FIRST

As Modine Manufacturing Company has a continuous product improvement program, it reserves the right to change design and specifications without notice.

Building HVAC
Modine Manufacturing Company
1500 DeKoven Avenue
Racine, WI 53403
Phone: 1.800.828.4328 (HEAT)
www.modinehvac.com

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